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THE

TEA QUARTERLY

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OF THE

TEA RESEARCH INSTITUTE

OF CEYLON.

Edited by

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Director, Tea Research Institute.

THE TEA RESEARCH INSTITUTE

St. Coombs, Talawakelle,

Ceylon.

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The Tea Research Institute of Ceylon.

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ROLAND VICTOR NORRIS, D.Sc., AN APPRECIATION.

by

ROBERT C. SCOTT, C.B.E.
Chairman of the Board.

An excellent history and appreciation of Dr. Roland Victor Norris appeared in the 'Daily News' of May 22nd, 1950.

Having been closely connected with the Tea Research Institute of Ceylon since its institution in 1926 and its Chairman since 1944, I hasten to add my official tribute to a Scientist who has been largely responsible for the development of the Institute from its early days to its present considerable quarters and status.

A glance at my book shelves, containing the records of the Institute, is a reminder of the tremendous amount of research and experiment that has taken place over a period of 20 years or more; the results of which have reacted in considerable knowledge and benefit to the Tea Industry.

Dr. Norris will be remembered, too, for his work as Organiser of the Fertiliser Rationing Scheme from 1942 to 1949. It was a pleasure to be associated with him in this scheme, which was organised with such detail and thoroughness as to earn the general commendation of all who were affected by or associated with it.

As Chairman, I found Dr. Norris always eager to put forward proposals for the advancement of the Institute, and ever ready to bear in mind the welfare of the Senior and Junior Staff.

I feel I cannot do better than reiterate words used by Mr. J. Lamb in his tribute to Dr. Norris — to the effect that the considerable and attractive quarters on St. Coombs, as well as the status and influence to which the Institute has aspired, will be a lasting memorial of his perseverance and industry. It is fitting that, in the near future, some form of Memorial at St. Coombs should record the name of Dr. Roland Victor Norris, D.Sc., as a Director whose services to the Tea Industry were outstanding.

ROLAND VICTOR NORRIS, DSc., 1888—1950.

Dr. Roland Victor Norris died at Port Shepstone, South Africa, on the 28th April, 1950, at the age of 62 years. Dr. Norris went to South Africa, in November, 1949, on holiday and was due to return to the Tea Research Institute of Ceylon of which he had been Director since 1929. His death is a sad loss to the Institute he served so well, and a personal misfortune to his many friends, amongst whom may be included the whole of his Staff. After graduating from Manchester University, Dr. Norris became private assistant to Professor W. H. Perkin. Moving to the Lister Institute of Preventive Medicine, London, in 1910, he joined Professor Arthur Harden's School and took part in the classical researches on the mechanism of alcoholic fermentation by yeast enzymes, for which work he was eventually awarded the D.Sc. degree of the London University. In 1912, during his career at "the Lister" he was elected to a Beit Memorial Fellowship.

Dr. Norris's long career in the East began in 1914 when he accepted the post of Physiological Chemist at the Imperial Bacteriological Laboratory in India. His first administrative experience was gained in the Indian Army in which his administrative abilities were soon recognised after a brief period of active service in 1915.

From 1918 onwards, Dr. Norris gradually turned towards agricultural research, first becoming Agricultural Chemist to the Government of Madras. When Professor of Biochemistry in the Indian Institute of Science, Bangalore, from 1924 to 1929, his research students were largely occupied with biochemical problems relating to agricultural subjects such as soils, plants, manures, the lac industry and the spike disease of sandalwood.

In 1929, Dr. Norris was appointed to the Directorship of the Tea Research Institute of Ceylon, when the construction of the permanent quarters at St. Coombs was just starting. The Institute has grown from its foundation on St. Coombs Estate, to its present status, under his guidance and will be a memorial to his industry so long as it exists.

"R.V." as he was known to his colleagues was by no means a pedant. He was a widely travelled and well read man of many interests. Actively interested in sports, particularly rugger and hockey, he regularly attended district games after he gave up playing himself. He enjoyed an evening at the Club as well as any planter, and took part in many social activities, especially amateur dramatics. In his later years he became keenly interested in Freemasonry and achieved the rare distinction of occupying the Chairs of two Lodges under the English Constitution and one under the Irish Constitution.

European, Indian and Ceylonese colleagues of two generations will remember R.V. with affection. Many members of the Tea Industry will remember Roland Norris either as a personal friend or as a personality. His obituarist having worked under his direction for sixteen years may perhaps be excused a personal tribute to R.V's tolerant but firm direction, critical but staunch support and his fatherly guidance and encouragement.

J. L.

THE TEA QUARTERLY.

VOLUME XXI. JUNE/SEPTEMBER, 1950. PARTS II & III

EDITORIAL.

The irregular intervals at which the *Tea Quarterly* is published calls for explanation and an apology.

During the war years shortage of Staff, and later of paper, made the regular publication of this Journal exceptionally difficult, to the point where in 1948 it was found to be impossible to produce Volume XX in its normal sequence.

In 1949 the position improved appreciably and the first part of Volume XXI was produced in March 1950 at its appointed time. The untimely death of Dr. Roland V. Norris, who edited this journal from 1929 during his tenure of his Directorship of the Tea Research Institute, has, however, led to further difficulties and another delay in publication.

Parts II and III are therefore combined in this Number and every effort will be made to publish Part IV at the end of 1950.

Publications are, it is fully realised, an important part of the Institute's functions and one which must receive priority in attention. Monograph No. 2 (The Commoner Diseases of Tea by Dr. C. H. Gadd) was produced earlier this year. The large number of illustrations gave rise to many difficulties: pathological specimens are troublesome subjects to photograph and satisfactory photographs do not, by any means, always make good blocks for printing purposes. Consequently, before Monograph No. 2 was finally published a number of the specimens to be illustrated had to be rephotographed after a search for fresh specimens. Many blocks were re-made and a moderate charge was made for this publication to cover part of the cost of its production.

Monograph No. 2 was not, therefore, sent automatically to all the addresses on the mailing list for the *Tea Quarterly*. It has been advertised in the Ceylon press but a considerable number of copies remain unsold.

The task of preparing Monograph No. 3 which should deal with Tea Manufacture unfortunately devolves upon the new Editor of this Journal. This is an unfortunate coincidence and means inevitable delay in the production of the third Monograph.

Some enquiries about the recent volumes of the *Tea Quarterly* are often received from readers wishing to bind their copies together. An index of recent volumes is given below.

1942, Vol. XV, Parts I & II only.
1943, Vol. XVI, Parts I & II only.
1944, Vol. XVII, Part I only.
1945, No issue.
1946, Vol. XVIII, Parts I, II, III & IV.
1947, Vol. XIX, Parts I, II, & III/IV combined.
1948, No issue.
1949, Vol. XX, Parts I, II, & III/IV combined.
1950, Vol. XXI, Parts I, II/III combined and Part IV to follow.

Attention is also drawn to the presentation of the current volume in the improved form at (compared to war economy measures) which has been adopted.

*A METHOD OF BRINGING TEA PLANTS INTO BEARING WITHOUT CENTERING

G. G. PERKINS

(Rye Estate, Balangoda.)

(Received 19th March, 1950).

To many planters, particularly in the dry zone, who, like me, have seen large numbers of young tea plants die back after centering, the following experiment undertaken throughout a recently opened clearing of 120 acres, planted 3½ ft. × 2 ft. on the contour, may be of interest.

Each plant, as it reaches the height of a foot or over and pencil thickness at the base, is bent over parallel to the ground and along the contour and is pinned down with a forked stick (not layered). From the bent-over stem numerous young shoots burst forth in a few weeks time, many of them from the base of the plant. (See plate). Later, as each shoot matures, it is tipped at a suitable height to form a plucking table. In addition, if it is required to increase the spread of the bush still further, the shoot nearest to the base of the plant can be bent over in the opposite direction and pegged down — with the same results as obtained from the original bent-over stem.

This, I maintain, has great advantages. Firstly, it eliminates the need to centre, which is a risky business in dry districts and one responsible for many deaths, and also a consideration of some importance in wet districts where the new shoots from centred plants are very susceptible to damage from blister blight. Each plant is allowed to retain all the leaf it produces. Growth receives no check as it does when centering is undertaken. With more leaf retained in the early stages, root growth is promoted, a plant matures much more quickly, and a good ground cover of tea is achieved sooner.

The clearing mentioned above which was planted only two years ago and was treated in this way is now in light plucking, with many bushes having a two-feet spread at plucking level and already nearly meeting in a continuous hedge along the contour. This tea is being brought into bearing with the advantage of being entirely free from any cuts or wounds. Supplies in old tea have been similarly treated with good results.

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* The Institute does not necessarily endorse the views expressed in papers contributed by persons other than members of the staff.

Photograph showing effect of bending over of young plant.
Note the large number of new shoots developed.

Investigations into the Methods of Increasing the Outturn of the Fannings Grade.

E. L. KEEGEL.

Prior to 1939, the fannings grade often commanded a higher price than B.O.P. especially in the London Market where the Blenders purchased their requirements directly at the Auctions. In addition to this demand for fannings there was a general tendency to prefer small neat B.O.P's to the larger types of this grade.

The Blenders in the U.K. appear to use only teas of the size of small B.O.P. and fannings in all the popular blends. In canteens and restaurants small leaf and even dust is favoured on account of its economy and rapid brewing properties.

During 1946 it was noticed during visits to blending establishments in the U.K. that normal B.O.P. was cut as a matter of course and it appeared highly illogical that fannings and small B.O.P. should find so little favour in the open market in Colombo while bulk buying prevented the U.K. blender from buying his exact requirements directly.

Possibly the return to more normal trading conditions will result in a marked increase in demand for fanning grades. Mr. Keegel commences his article with a reference to an increase in the demand for this grade already apparent in the Colombo Market and proceeds to give an account of his investigations into methods for producing smaller leaf. Research into methods of tea manufacture is greatly complicated by the fact that there are no fundamental standards by which tea can be valued. Nobody can say exactly what any tea is worth until the Auctioneer's hammer falls Nevertheless there are distinct trends in market requirements and Mr. Keegel has endeavoured to anticipate possible changes which will be required in manufacture to meet future requirements.—(Editor).

For some time in the latter half of the year, 1949, anyone closely following the trend of the Colombo tea market would have noted the increasing prices realized for the Fannings grade. Some estates naturally altered their grading procedure to take advantage of the increased demand for this particular grade while a few changed their rolling technique with the same object in view, namely, to increase the Fannings outturn. The question of which procedure gives the best return is a vexed one. It is hoped that the results of these investigations will help to clarify the doubtful points arising from the adoption of either method.

It is well known that the Fannings grade falls into two main categories, one being the flaky type and the other the grainy variety. Generally speaking, the former is larger in size, the smaller the size of the grade the more grainy it is considered to be. However, this must not be taken as a hard and fast rule because a small flaky Fannings could still be obtained by rolling under-withered or overwithered leaf. There is also another type of Fannings referred to as leafy, this term being used to indicate the presence of big pieces of leaf that are not open. In order that no confusion should exist regarding these terms the following definitions are given for the purpose of this article.

Grainy.—Term applied to a well made grade, the generally accepted standard of size being that taken through a No. 16 or 18 mesh size. Anything larger than this is considered *leafy*. *Flakiness* explains itself and is not regulated by size.

The investigations carried out into the production of increased outturns left out the question of small size, flaky Fannings because the methods employed to produce this type would have been abnormal and secondly, the low prices paid for them would have nullified any advantages accruing from an increased outturn.

The question, therefore, resolved itself into one of increasing the outturn by methods practicable in an ordinary factory and of producing a *marketable* grade at the same time. A number of promising methods were available but on trying them out only a few gave the desired results. Nevertheless a record of the more important experiments is given for general information. It must be clearly stressed of course that the adjustment of grades to pre-arranged requirements is not an evolutionary idea in tea manufacture. Many factories do in fact alter their manufacture from time to time to suit special market demands but how many really do so without any consideration of its effect on the grades other than the one on which most attention is paid ? The purpose of these investigations was to find how best to increase the outturn of the Fannings grade from an economic point of view.

The first stage in the experiments was to try to obtain an appreciable increase in the outturn by altering rolling technique. Some of the more familiar methods for which many claims have been made, actually failed to do so the reasons for which only became clear when subsequent experiments were carried out. The second stage, which involved a change in grading procedure enabled higher outturns to be obtained. Some experiments employed both methods.

The size of mesh for separating the Fannings grade in these experiments, unless otherwise stated, was No. 18, this being the mesh commonly used. The material worked with was ordinary estate leaf subject to the usual degree of variation in wither.

Rolling under heavy pressure seemed to be the method most likely to give the required increase in the outturn of the Fannings grade. In fact it did not result in any change in the outturn of this particular grade or for that matter in that of the other grades. Appearance of the teas from the point of view of twist was slightly improved but quality was appreciably marked down. Tip was also lost in the process.

Effect of increasing the number of rolls.—Additional rolling also failed to make any appreciable difference in the outturn of the Fannings grade but imparted more tip due to the lower initial dhool outturns.

Continuous Pressure versus 5 minutes on 5 off :—Rolling under continuous pressure made very little difference to the outturns of any of the grades and there was very little indeed to choose between the two methods in respect of liquor or appearance.

Other variations of pressure application such as 8 minutes on, 2 off and 7 on and 3 off also had hardly any noticeable effect and the question naturally arose why such methods were ineffective.

The controlling factor seemed to be the Big Bulk outturn which in the experiments previously referred to was the same in each comparison. There was strong reason to believe that this was so because in a subsequent experiment where the Big Bulk outturn was high even under heavy pressure the Fannings outturn was found to be lower than that obtained from light rolled leaf which had a relatively lower Big Bulk outturn. Further confirmation was obtained from an analysis of the dhools of a normal 5 roll programme :—

	% outturn	.....% outturn of B.O.P. and F.P.	% outturn of Fannings and Dust
Dhool 1	16	14.5	1.5 (9% of dhool)
„ 2	18	16	2.0 (12% of dhool)
„ 3	20	17.5	2.5 (13% of dhool)
„ 4	21	15	6.0 (31% of dhool)
„ 5	19	12.5	6.0 (33% of dhool)
Big Bulk	6	—	—
	100	75.5	18.0

The figures given above are worth a close study and show how misleading such statements as "extra rolling has increased my Fannings outturn" or "I have now resorted to heavy pressure as a result of which I am getting more fannings" could be. The increase in outturn, if any, was due entirely to the reduction of the Big Bulk brought about by the change in rolling. For instance, in the figures just quoted, assuming a negligible contribution of Fannings and Dust from cutting of the Big Bulk, the outturn of these two grades would vary as follows :—

6% Big Bulk — 18% Fannings and Dust.
25% Big Bulk — 12% „ „ „
46% Big Bulk — 6% „ „ „

To say, therefore, that an increased outturn of Fannings is obtained from heavier rolling or increasing the number of rolls is meaningless unless the expression is qualified with the amount of Big Bulk outturn. To decide whether a higher Big Bulk outturn (lower percentage of Fannings) is better than a smaller Big Bulk outturn (higher percentage of Fannings) all the grades must be valued and the average price obtained. The effect on the average price depends of course on the locality of the factory (whether low elevation or high) and on the state of the market, and is a matter for experiment by anyone interested. Suffice it to say that the lower Big Bulk outturn would result in more broken grades irrespective of what form of rolling is adopted.

Another important factor generally lost sight of is the influence of size of the roll-breaker mesh. It was shown that heavy pressure gave the same results as light pressure. In these experiments the same roll-breaker mesh was used and the same Big Bulk outturn aimed at. Dhool outturns were naturally higher for the heavy pressure teas on account of the less number of rolls done. In another series of experiments, however, where the same number of rolls were done but by the use of smaller mesh, dhool percentages adjusted to the figures obtained for light rolling, the heavy pressure yielded more Fannings by about half its normal outturn. The effect on valuations was as follows :— All the grades except the dusts of the normal rolled teas were preferred in appearance and quality. The extra colour and strength contributed by the heavy pressure did not compensate for the diminution of these two characters. Loss of tip as a result of heavy pressure combined with the effect of smaller mesh was the notable feature.

Further studies of the influence of size of mesh may be summarised as follows :—

No. 4 mesh versus No. 5 mesh.—The increase in the Fannings Grade outturn was only 4% or thereabouts with the smaller mesh. There was very little difference between the two types of Fannings obtained except that the former had a little more tip on account of which it was valued slightly more than the other. The most marked effect of the larger mesh was to increase the outturn of the Flowery Pekoe grade from 7 to 20%. These results were obtained with equal dhool outturns by decreasing the pressure on the No. 4 mesh teas but on repeating the experiment with *equal pressure applications* the outcome of which was to increase the percentage dhools for the former, the Fannings grade was considered appreciably worse in appearance.

No. 5 mesh versus No. 6 mesh.—Once again the use of the smaller mesh resulted in more Fannings being produced, as much as 15% being obtained as against 8% from the former. The Fannings from No. 6 mesh was similar in size perhaps a little blacker, otherwise there was no commercial difference. It is of interest to note that the F.P. percentage of 20 obtained with *No. 4 mesh* dropped to 3% on using No. 6.

Here seemed a possible method of increasing the Fannings grade outturn but the lower valuation obtained for the B.O.P. grade (from No. 6 mesh) counteracted to some extent any advantage resulting from the production of more Fannings.

Effect of double roll-breaking the dhools.—The results obtained were practically identical with those from the use of a smaller mesh on the roll-breaker.

Continuous rolling.—The method adopted here was to roll the leaf continuously for the same length of overall time as normal rolling without breaks for roll breaking. Pressures were increased at the appropriate times consistent with normal conditions and a final roll-breaking done to remove the Big Bulk. The average grade outturns of a number of experiments were as follows :—

		Continuous Rolling.	Normal Rolling.
B.O.P.	...	50	56
F.P.	...	7	14
Fannings	...	14	8

The outturn of the Fannings grade was almost doubled as a result of this method with a corresponding reduction in the B.O.P. and F.P. outturns. Dusts increased slightly by 1%. The Tasters' remarks and valuations were "Normal has considerably more tip than the other which is inclined to be choppy. Fannings of normal is worth 10-15 cents more on to-day's market and so is the B.O.P."

The experiment, therefore, yielded no useful results, no advantage being gained in this particular instance in the increased Fannings outturn. It is possible that had tip been retained by separating the first dhool an increased value might have been obtained for the Fannings grade but it is open to question whether such a procedure would have benefited the other grades as well. So many modifications could be carried out in tea manufacture that to consider each one in turn would undoubtedly be a lengthy process. Only general principles were considered in these investigations.

The results of the experiments up to now indicated quite clearly that the Fannings outturn is chiefly influenced by two factors, namely, the size of roll breaker mesh used and the total amount of dhool taken out, that is to say, the amount of Big Bulk left over. The appearance of this grade was governed by the absence or presence of tip which was destroyed either by heavy rolling in the early rolls or continuous rolling. Hence, it seemed probable that to get the best results it would be necessary to apply heavy pressure in the later

rolls only. This was done but the grade outturns were *not* affected. The results of this experiment provided further confirmation of the fact that the application of heavy pressure either in early rolls or last rolls made no material difference to the outturn of the Fannings grade.

It is probable that exceptionally heavy pressure would have a marked effect but on account of the practicable limits to which heavy pressure could be applied in an ordinary Batten/Pressure cap roller attention was turned to the use of Epicyclic pressure rolling and cutting battens for bringing about the production of increased Fannings. These two in turn will now be dealt with.

E. P. Rolling.—It must be emphasised that by employing suitable E.P. fittings to get orthodox dhool outturns no fundamental difference is observed between E.P. rolling and Batten/Pressure cap rolling either in outturn of grades or the appearance thereof. The use of an extra large fitting however, for the second rolls enabled more Fannings to be produced without loss of value but at the expense of the other grades. The results are of interest and are given below without comment.

		EXPERIMENT, 2 × 20 minutes.	CONTROL. 3 × 20 minutes.
No. of rolls			
% dhool outturns:	1	18	18
	2	75	28
	3	—	42
	B.B.	4	9
% grade outturns:	B.O.P.	48	64
	F.P.	3	7
	Fannings	21	10
	B.P.	2	4
	Dust	11	3
	B.M.	8	9
	Waste	7	3
	Total	100	100

Valuations.—(Control taken as standard for comparison).

Grade	Appearance.	Colour.	Strength.	Quality.	Comparative valuation in Cts.
B.O.P.	S.W.	S.W.	S.W.	E.	— 7
F.P.	S.W.	S.W.	S.W.	E.	— 3
Fannings	E.	S.W.	S.W.	E.	0
B.P.	S.W.	S.W.	S.W.	E.	— 3
Dust	S.B.	S.W.	S.W.	E.	+ 5

S.W = Slightly worse; E = Equal; S.B. = Slightly better.

In the light of these results it was clear that too high a dhool outturn though increasing the Fannings gave all-round unsatisfactory results. It was then thought that a lower dhool outturn would effect an improvement and an experiment was done to test this out. Instead of one final roll to give 75% dhool, two rolls were done and a smaller fitting used in the first roll to give less dhool so that there would be sufficient leaf for the 2nd and 3rd rolls. The dhool outturns obtained were 10, 55, 24 and B.B.6, but the effect on the Fannings grade was very small. An increase of only 3% over the control was noted. Dusts, however, showed the same remarkable rise as in the previous experiment. A secondary effect of taking these large abnormal dhool outturns was to produce more "addapu" dhool, more than twice the normal amount being obtained.

Cutting Battens.—The use of severe forms of cutting battens affixed to the door of an ordinary batten/pressure cap roller resulted in the Fannings outturn being almost doubled. The general result was almost the same as that obtained

from severe types of E.P. fittings, the value of the Fannings being hardly affected whereas the other grades received a lower valuation than the control on account of poorer appearance and liquor.

Having thus exhausted all the possible methods of approach to increasing of the Fannings outturn by different rolling techniques, the next stage in the investigation was confined to alterations in the grading process. The results are set out below.

Effect of cutting the B.O.P.—An unconventional method was tried out. A Savage cutter was employed. The procedure adopted was to cut the fraction over a No. 18 mesh sieve, normally taken as B.O.P., sieve the cut leaf again and to repeat the operation a number of times. With each cut there was a progressive decrease of B.O.P. and a corresponding increase of fannings, but after the 5th cut the effect was not so noticeable. Working with a normal B.O.P. (Outturn of 67%) it was possible by this means to lower its percentage to 50 and increase the Fannings grade by 15%. The rest of the 2% of leaf was crushed to good saleable Dust in the process.

Increase in percentage outturn.

	Fannings.	Dust.
After first two cuts ...	6.7	0.8
„ third cut ...	2.5	0.4
„ fourth cut ...	2.3	0.4
„ fifth cut ...	2.1	0.4
„ sixth and seventh cuts ...	1.7	0.6
Total increase ...	15.3	2.6

This method seemed to be promising enough to produce an appreciable increase in the Fannings grade outturn, so a true comparison was made and the samples sent to Colombo tasters for their opinion. The B.O.P. was given 5 cuts, the effect of which was to alter the grade outturns as follows:—

B.O.P. dropped from 71 to 57%
Fannings increased from 10 to 21%
Dust increased from 5 to 6%,
and Broken Mixed increased by 2%.

The result of cutting the B.O.P. was to change the appearance considerably. Liquors, however, were not affected, but as a result of the poorer appearance in the cut teas the B.O.P. was valued down 3 cents and the Fannings 4 cents. The effect of the cutting was to produce *brownish* teas. Although the cut B.O.P. was smaller and neater and more even it was rather nearer B.P. in appearance. The appearance of the Fannings grade but for the brownish character was considered quite good and would have sold well depending on market requirements.

Cutting the B.O.P., therefore, was obviously not a worthwhile proposition, so the only method available was then adopted, namely, taking the Fannings grade through a larger mesh. Feeding the B.O.P. slowly over a sifter would also increase the outturn of Fannings but the final result is the same. A larger size Fannings is ultimately produced. Experiments were conducted with teas normally rolled, rolled by E.P. methods, and taken through different size roll-breaker meshes. In every instance the B.O.P. had a preferable make and the Fannings grade was much leafier than the standard (taken through No. 18 mesh). Liquors, remarkable to say, were again not affected, as a result of which the Fannings grade taken through the larger mesh received a higher valuation of about 3 cents more than the standard, but the B.O.P's were valued the same. The mesh used for these experiments was No. 14 and its effect on the grade outturns is shown by the following figures (average for all the experiments).

B.O.P. dropped from 69% to 53%
Fannings increased from 11% to 27%.

The results are undoubtedly significant but under present market conditions it is not worthwhile to make the extra Fannings. A simple calculation shews this quite clearly. Taking the average valuations of these samples which were as follows :—

B.O.P's (same in both cases)	...	Rs. 2/79
Fannings through No. 18 mesh	...	„ 2/73
„ „ „ 14 „	...	„ 2/76

1,000 lbs. of tea, so graded would realize the following prices :—

Teas through No. 18 mesh.		
69% B.O.P.	— 690 lbs.	Rs. 1,925.10
11% Fannings	— 110 lbs.	„ 300.30
		Total Rs. 2,225.40
Teas through No. 14 mesh.		
53% B.O.P.	— 530 lbs.	Rs. 1,478.70
27% Fannings	— 270 lbs.	„ 745.20
		Total Rs. 2,223.90

Admittedly, had the larger Fannings grade been valued much higher some advantage would have been gained but it must be borne in mind that for there to be any wide margin of preference for the No. 14 mesh teas the two B.O.P's would have to fetch at least the same price. The market today is, however, so difficult to forecast that had these experiments been conducted at a different time the larger B.O.P's (from No. 18 mesh) might have found more favour in which case the increased outturn of the Fannings grade would only have been obtained at the expense of the B.O.P. The fluctuation of market requirements is illustrated by the fact that the Fannings grade which had such a strong market in 1949 has now fallen off in demand possibly due to a glut of this particular grade as a result of over-production. A further illustration may be drawn from the type of Fannings now required. The chief criterion of value in 1949 was appearance, but today it seems to be the good liquoring Fannings that command the best prices.

The question of increasing the percentage of the Fannings grade is, therefore, one surmounted with innumerable difficulties and is mainly an economic one. Special market requirements, seasonal variations, the state of the market, and other factors arising from these, have all to be taken into account when making any change in the percentage of grades. Various methods bearing on the Fannings grade outturn have been described and the results given. Some have resulted in no change while others have caused an appreciable effect. Whichever method is adopted the guiding factor should be not the price obtained for the Fannings grade but the average for all grades. This point need hardly be stressed as it was conclusively shown that the improvement of one grade generally results in a lessenning of some character in another.

SUMMARY.

1. Change of rolling technique in respect of pressure and number of rolls made little difference to the Fannings grade outturn.

2. E.P. rolling also made hardly any difference but the use of severe E.P. fittings to crush the leaf did bring about a considerable increase. This method, however, had an adverse effect on the main grades. There was also a marked increase in the Dust outturn.

3. Continuous rolling also gave an appreciable increase in the outturn of Fannings but the resultant teas were poorer than those from the orthodox rolling process.

4. The Fannings outturn was governed by the size of roll breaker mesh used, No. 6 mesh producing nearly twice as much Fannings as obtained from a No. 4 mesh. There was hardly any commercial difference between the Fannings obtained from No. 4 or No. 5 or No. 6 mesh, but the main grades from No. 5 mesh received the most favourable reports. As the influence of the size of the mesh was most shown in the outturn of the F.P. grade the true benefits of an increased Fannings outturn cannot be judged unless the market value of the other grades is taken into account.

5. Double roll breaking had a similar effect to a smaller roll-breaker mesh.

6. Forcing the grade by the employment of severe cutting battens caused an increase of the Fannings outturn without any ill effects to this particular grade, but the main grades lacked twist and liquors were inferior.

7. The importance of the Big Bulk outturn must not be lost sight of when interpreting results obtained by any change in rolling technique.

8. To obtain any appreciable effect by rolling, dhool outturns must be exceptionally high. To accomplish this result special battens have to be fixed to doors of normal Batten/Pressure cap rollers of larger fittings to E.P. rollers.

9. The effect of cutting the B.O.P. was to produce more Fannings but in doing so the B.O.P. grade was spoilt. To obtain an appreciable increase it was found necessary to cut the B.O.P. at least 5 times. Reducing the number of cuts would still have an adverse effect on the appearance but to a lesser degree.

10. The most promising method and the one that gave the most satisfactory results was that which employed the larger mesh in sifting. A leafier variety was produced which in turn resulted in a smaller B.O.P. Whether these two in conjunction would find more favour than a grainier type of Fannings and a larger B.O.P. would of course depend on the market.

STUDIES IN BLISTER BLIGHT CONTROL

I. THE PROGRAMME OF RESEARCH

J. LAMB

Following the report on "Blister Blight in Ceylon Tea Plantations" submitted to the Tea Controller in November 1949 and published in the *Tea Quarterly*, Vol. 20, pts. 3/4, page 149, a grant of Rs. 150,000/- has been received from Government for blister blight control work during 1950.

This vote has enabled the definite planning of the blister blight campaign and as the results of experiments become available they will be published in this series of articles.

Plans include the following lines of investigation :—

1. Large Scale Experiments.

A 200-acre scale experiment on the protection of tea recovering from pruning has been started on Kataboola Estate, Kotmale, where blister blight attacks are severe throughout the year and where a variety of terrain is available. Weather conditions are also severe in the Kotmale district and should afford a chance for trials under extreme weather conditions.

2. Extensive Experiments.

50-acre scale experiments on a series of estates ranging from Hewaheta to Nuwara Eliya and from Hatton to Ramboda have also been started.

Courses of instruction for the superintendents of the estates concerned and for labourers to be employed in spray gangs were held at the Institute in June and July.

3. Engineering Division.

The services of an engineer, Mr. J. Landreth, have been secured and a workshop is being established at the Institute. These facilities will greatly assist in the investigation of application of fungicides which is the most important field for immediate investigation.

4. Fungicides.

A search for fungicides more effective than the present range of copper based fungicides must be made.

With the co-operation of the Shell Company's laboratories in Amsterdam, who have loaned the services of Dr. J. W. Pfaeltzer, a large scale screening of a wide range of fungicidal compounds is already in progress.

5. Spray Application.

The practical aspects of the application of fungicides by knapsacks and the organisation of spraying in the field are so important that we have arranged to hire the services of Mr. C. L. Scoles, who has a wide range of experience of spray application from Messrs. Plant Protection Limited.

6. Dusting.

Dr. H. Dike of Universal Crop Protection Limited asked for facilities to carry out experiments with dusting and mist blowing during the south west monsoon period.

Arrangements have been made to give Dr. Dike all the facilities he requires.

7. Protection of Tea in Plucking.

Experiments with the protection of tea in plucking have been commenced at the Institute and a full investigation of the question of spray residues and their effect on quality is in progress.

STUDIES IN BLISTER BLIGHT CONTROL

II. Preliminary results of tests with fungicides

C. A. LOOS

In October 1946, when blister blight made its first appearance in Ceylon tea plantations, the immediate problem that confronted the Tea Research Institute was the devising of such control measures, whereby the severity of outbreaks could be minimised and held in check. At the onset it was realised that, due to the wide differences in climatic conditions between North India and Ceylon, control measures adopted in that country might not be completely effective

out here. Until more was known of the course of the disease recommended control measures had to be based on purely agricultural practices, the chief of which was the careful regulation of pruning seasons and pruning methods. Pruning had to be timed so that pre-tipping growth was established during the periods of dry weather, under conditions unfavourable to the growth of the fungus. This recommendation, though it upset the normal routine on many estates, was sound in principle, for it allowed the bushes to form maintenance foliage which would become resistant to infection before conditions favoured the growth of the fungus. Unfortunately, in some cases, that advice was not followed.

Four years ago we should have considered a test for starch reserves, on roots of tea bushes on estates above 2,000 feet elevation, a waste of time. Today starch deficiency is the direct cause of thousands of bushes failing to recover from pruning even at elevations above 5,000 feet. Admittedly, manurial deficiencies, such as the shortage of potash, are a contributory cause but in many cases the loss of pre-tipping leaf, following on blister attacks, is the main reason. Continued plucking of bushes of maintenance leaf must inevitably lead to their destruction through starvation.

Before protection against blister blight, by the use of fungicides, became possible. More had to be known of the causative fungus as, without that basic knowledge, any experimental programme was doomed to failure. The necessary investigation was, under the direction of Dr. C. H. Gadd, completed by the end of 1948. It was, therefore, possible to conduct small scale spraying experiments in 1949 when four problems called for careful consideration —

(1). The choice of suitable fungicides.

(2). Protection of tea recovering from pruning under monsoonal conditions.

(3). Protection of tea in plucking during blister blight attacks.

(4). The most efficient means of applying fungicides.

I. The Choice of Suitable Fungicides.

Dr. Tubbs' preliminary experiments showed that *Exobasidium vexans* is susceptible to control by copper based fungicides. Fungicidal preparations depending, for their activity, on elementary sulphur have little effect.

A number of proprietary copper based fungicides are now available in Ceylon amongst which are —

Perenox — A cuprous oxide formulation manufactured by Messrs. The Imperial Chemical Industries.

Blitox — A copper oxychloride formulation made by Messrs. Pest Control Limited.

Shell Copper Oxychloride.—A formulation made by the Shell Company.

Coppesan — Messrs. Boots (U. K.).

Yellow cuprocide — Messrs. Rohm & Haas, U.S.A.

Copper Sandoz — Messrs. Sandoz Limited, Switzerland.

To these preparations may be added the following which will be on the market in the near future.

Kuprokylt — A Dutch product.

Concentrated Copper Lime — A German product.

We are not aware of any marked differences between the efficiency of these proprietary copper fungicides but our experience of all but Perenox is limited. In testing organic fungicides we have therefore taken Perenox as a standard for comparison. The copper oxychloride fungicides are green in colour making it difficult to judge the volume of spray fluid against the dark green of the leaves.

Unless carefully supervised the spray gang finds it difficult to judge the amount of cover being put on till the spray fluid runs off the leaf. Fungicides intended for field application incorporate in the formulation a sticker and spreader. The sticker has adhesive qualities which cement the small particles of the fungicide on the leaf while the spreader tends to give an even distribution over the sprayed surface. Different manufacturers claim distinctive merits for their various formulations. There is a definite limit to the amount of work the Institute can undertake to test these claims. We have, however, tested a copper oxychloride formulation (Blitox) against a cuprous oxide formulation (Perenox).

Cuprous oxide vs. copper oxychloride.—An area of tea pruned at the beginning of October was divided into three approximately equal plots, their location being such that almost similar conditions prevailed. The site selected was above a marsh where blister blight had previously been known to flourish.

Two plots were sprayed at 10 day intervals with Blitox and Perenox, each at a concentration of 4 ozs. fungicide in 10 gallons of water, the spray output being approximately 12 gallons to an acre. The third plot was left unprotected to serve as a comparison for the intensity of blister infections, during the course of the trials. Spraying commenced at the first sign of bud-break on 28th October, 1949.

For the purpose of the experiment weather conditions were ideal. Each spraying operation being conducted in fine weather, the fungicide application drying on the leaves before the advent of rain. Table I shows the weather conditions which prevailed between bud-break and tipping, at which time the experiment ceased.

TABLE I.

Weather Conditions

Week ending	Rainfall in inches	No. of rainy days	Average rainfall per day Inches	Sunshine per week		Average Sunshine per day	
				Hrs.	Mins.	Hrs.	Mins.
3-11-49	0.82	3	0.12	49	28	7	07
10-11-49	2.14	5	0.31	33	28	4	47
17-11-49	3.17	4	0.45	45	27	6	20
24-11-49	1.73	4	0.25	37	33	5	22
1-12-49	0.75	4	0.11	29	17	4	11
8-12-49	3.74	3	0.53	9	54	1	25
15-12-49	0	0	0	4	16	5	45
22-12-49	0.43	6	0.06	*	0	*	0
29-12-49	4.86	5	0.69	11	19	1	37
Total 28-10-49 to 29-12-49	17.64	34	0.28	220	42	4	38

* Sunshine Recorder out of order.

For the 9 weeks during which spraying was continued there were 34 rainy days with an average of 0.28 inches rain a day.

At the termination of the experiment a row of tea in each plot was pruned and counts made of stem infection, leaf infection and dead shoots. The results are tabulated in Table II.

TABLE II.

Infections on pre-tipping growth.

Treatment	Average infections per bush on stems	Average infections per bush on leaves	Average dead shoots per Bush
Blitox	1.1	3.0	0.3
Perenox	0.6	2.5	0.1
Unprotected	12.6	168.5	2.0

Both fungicides gave excellent control of blister blight but there was no evidence of extra retention, and therefore better control, with either of the two preparations. To all practical intents and purposes they were equally good so far as may be ascertained on preliminary trials.

Concentrated preparations.

A preparation called Yellow Cuprocide said to contain 80 per cent of copper as against the more usual 50 per cent was compared with Perenox on tea in bearing. The Yellow Cuprocide was used at a concentration of 2½ ozs. per 10 gallons and Perenox at the normal rate of 4 ozs. to 10 gallons water.

TABLE III.

Percentage infection of flush and banji

Pluck	2nd	3rd	4th	5th	6th	7th	8th
Yellow cuprocide	18	5	21	16	11	15	4
Perenox	15	8	16	11	2	9	7
Unprotected	73	75	89	78	66	59	34

The degree of control between Perenox and Yellow Cuprocide is not significantly different but compared with the unprotected plot they both have very marked effects as shewn in Table III.

It is unlikely that the Institute will undertake further work on testing of copper fungicides unless a new preparation has some very desirable feature, such as a low price.

II. Protection of Tea Recovering from Pruning.

The planning of any pruning programme should depend on a number of factors. Obviously, the chief criterion has to be crop returns and pruning for recovery during periods of short crops. Climatic conditions on Ceylon tea estates, vary so considerably that no hard and fast rule can be laid down for pruning in any one month. In the Dimbula area where both the North East and South West monsoons prevail, conditions are very different to those in the Uva district, where the South West monsoon does not occur. A careful study of crop returns is essential if the full benefits of spraying during recovery are to be obtained. As a guide, crop returns for the last ten years on St. Coombs are given in Table IV.

TABLE IV.

Crop Records

Month	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	Average 1940/49
January	14507	16639	17002	18317	20310	14948	20907	30848	14625	15043	18315
February	9131	14965	17161	12189	16923	9172	18793	17868	16510	9559	14227
March	11998	10251	16715	7518	24646	6730	16379	28245	11807	9952	14424
April	8548	24222	23797	9681	19056	15752	31723	28014	19594	9424	18981
May	20422	23197	24511	23429	22818	35736	29876	29313	29192	29681	26818
June	16882	17241	15849	9848	17714	11742	14729	22194	19666	10706	15657
July	12730	12070	11608	10150	15992	19364	11989	16626	6087	13844	13046
August	13090	13309	10744	9713	11889	11469	15754	10280	16076	10356	12268
September	13213	11514	17580	13474	13518	17372	12800	14048	16690	18220	14846
October	18963	20432	16638	15568	15380	14991	22930	18080	21970	10394	17535
November	15988	22301	19917	17908	17101	23891	21880	23924	21184	21523	20562
December	19868	17432	21279	18592	19470	20646	17946	22692	14243	15951	18812
Total	175270	203573	212801	166187	214817	201813	235706	262132	207644	174653	205460

Obviously the best time to prune will be at the end of June as the lowest cropping season is from July to September, while November and December again are heavy cropping months.

Bud-break will, of course, depend on the type of pruning adopted, a clean prune taking about 6 weeks, while with a lighter prune bud-break will commence in about four week's time.

Another important factor is rainfall. Spraying during spells of heavy rain will give little protection, as the fungicide will be washed off before it has time to stick on the leaf surface. On St. Coombs, as the rainfall figures in Table V show, the months of May, June and July are periods of heavy rainfall during which time spraying may serve a very limited purpose. As bud-break, on bushes pruned at the end of June, will not commence till early August, heavy rainfall in July can cause no inconvenience as spraying would start only after bud-break.*

TABLE V.

Rainfall—St. Coombs Estate

Month	1940	1941	1942	1943	1944	1945	1946	1947	1948	1949	Average 1940/49
January	0.04	1.97	3.15	1.09	1.98	0.14	2.35	3.72	4.27	3.37	2.20
February	3.65	2.13	1.82	0.96	4.86	0.45	1.78	1.32	0.06	0.49	1.75
March	1.35	5.70	5.97	1.75	8.93	3.43	6.96	6.41	5.36	1.74	4.76
April	5.41	10.16	8.27	4.11	4.54	7.58	7.96	3.99	10.13	8.29	7.04
May	27.39	27.52	7.06	28.08	12.15	2.33	2.57	7.36	10.01	6.95	13.14
June	14.34	10.51	15.97	20.96	7.48	11.52	8.73	6.65	16.79	11.07	12.40
July	8.14	8.87	23.14	18.33	6.89	8.80	7.97	4.86	14.21	10.80	11.20
August	7.62	13.80	10.47	8.10	2.24	10.27	16.05	26.25	4.81	9.41	10.90
September	5.26	8.20	8.92	12.70	5.69	4.27	11.42	8.60	2.62	8.07	7.57
October	6.74	11.64	8.54	9.16	16.93	10.48	7.56	13.22	7.44	10.73	10.24
November	10.35	10.20	3.51	9.21	10.95	10.92	7.48	3.12	6.50	8.40	8.06
December	3.34	3.26	8.00	10.23	4.52	3.60	10.52	5.58	6.82	7.34	6.32
Total	93.63	113.96	104.82	124.68	87.16	73.79	91.35	91.08	89.02	86.66	95.61

* These views have been modified by more recent experiments.—Ed.

During 1949 a small-scale experiment was carried out on St. Coombs on an area pruned on the 21st June. The plots, each of which contained six bushes, were randomised for four replications. Four plots were left unsprayed the other four being sprayed weekly with a copper fungicide at a concentration of 4 ozs. in 10 gallons of water. Spraying of the treated blocks commenced on 19th July, at the first sign of bud break, and continued till the bushes were ready for tipping at the end of September. The sprayed bushes recovered normally with almost a complete absence of stem infections while pre-tipping growth matured with only an occasional blister occurring on a few leaves. The unprotected bushes were a sorry contrast, as the shoots were repeatedly killed back by blister infections till about November, when brighter weather allowed new recovery. These unprotected plots were not ready for tipping till the end of January, 1950.

It has to be emphasised that this small scale experiment, though it indicated that spraying was very effective in controlling blister blight, must be repeated on a large scale to obtain fully reliable information. The rainfall on St. Coombs averages about 90 inches for the year. There are districts, badly infected with blister blight, in which the rainfall is over 150 inches. Treatments which are effective on St. Coombs may well be ineffective somewhere else. Large scale spraying operations involve many difficulties which can only be overcome by experience. That experience will be gained in the large scale programme arranged for this year, when selected estates in the Kotmale, Dimbula, Nanu Oya, Ramboda and Nuwara Eliya districts will conduct spraying trials during the south west monsoon.

In the Kotmale area, with an annual average rainfall of approximately 175 inches, the trials will be under the control of the Institute. An area of 200 acres will be pruned from the end of June onwards, while spraying with a copper fungicide will commence from bud-break and end at tipping. In the other areas, 30-50 acres will be pruned at the end of June. Though these trials will be under the supervision of the Superintendents of the Estates concerned, the Institute will remain in close touch with the work in progress.

Protection under north east monsoonal conditions has proved very successful. The area selected for an experiment was on an estate subject to heavy mists and low cloud, conditions ideally suited to blister blight attacks. A nine acre block was divided into three approximately equal plots one of which was left unprotected while the other two were sprayed at weekly and fortnightly intervals respectively. The fungicide used was Perenox at a concentration of 4 ozs. fungicide in 10 gallons of water. The area was pruned on 1st September and spraying operations commenced with bud-break on 10th October, continuing at the stated intervals until the plots were due for tipping at the end of December. This entailed 13 weekly spraying operations and 7 fortnightly applications, at a rate which ranged from 12-13 gallons per acre. The average cost per application was Rs. 2/- per acre, inclusive of the cost of labour and fungicide. This figure, however, does not include supervision and is averaged for a six hour working day. Under the conditions of the experiment the total cost of protection was Rs. 26/- per acre for the weekly application and Rs. 14/- per acre for fortnightly sprayings.

To facilitate transport and other arrangements spraying operations were scheduled for Monday in each week. Though no attempt was made to choose favourable weather conditions, it must be emphasised that every spraying date coincided with fine weather though rain and mist often persisted on other days in the week.

At the end of the experiment a count of bushes in the plots revealed that bush stand was irregular so the tipping weights have been corrected to give an average of 3,200 bushes to an acre. Table VI shows the harvested tippings at the end of the spraying trials. We are greatly indebted to Mr. Halliday, Superintendent of Uda Radella Estate, for the figures and to Messrs. Whittall & Company for granting permission to carry out the experiment.

TABLE VI.

Tipping	Fresh weight of tippings in pounds			
	1st	2nd	3rd	Total 3 tippings
Weekly sprayed area	423	230	470	1123
Fortnightly sprayed area	284	288	497	1069
Unprotected area	148	256	376	780

Taking the total tippings of the unprotected plots as a basis for calculation, the weekly sprayed area gave 44 per cent more tippings while the fortnightly sprayed area showed a gain of 37 per cent. These figures though they give a very striking picture of the effect of spraying are not the complete story. There are fewer branches on the unsprayed bushes and those that remain appear to have a gormandizing effect. It is safe to assume that loss of crop will continue throughout the cycle, the beneficial effect of spraying being felt in crop returns for a very considerable time.

A spell of dry weather in November turned what would have been catastrophe, as far as the unsprayed plots were concerned, to a period when recovery was made possible. The Superintendent expressed the fear that the three acres of unsprayed tea in the control plot might be a total loss; the difference in recovery was then so obviously apparent.

While mist and rain persisted through October and early November, the weekly sprayed plots showed no evidence of stem infections while leaf blisters were very few and hard to find. On the fortnightly sprayed bushes, stem infections were fairly extensive while leaf blisters were numerous. On the unprotected bushes both stem and leaf infections were heavy. Defoliation was fairly heavy from petiole infections on the unsprayed bushes.

At the end of the experiment a count was made on 100 bushes in each plot to ascertain the number of dead shoots per bush.

	Average number of dead branches per bush.
Unprotected ...	11.83
Weekly Sprayed area ...	1.46
Fortnightly Sprayed area ...	5.83

III. **Protection of Tea in Plucking.**

Very efficient protection of tea in plucking is possible with copper fungicides. If it were not for the undesirable feature of excessive copper residues in the manufactured tea, our problem of fungicidal protection would have been solved a considerable time ago. Our main efforts to find a suitable fungicide have, therefore, been directed to trial experiments with different organic preparations, which do not incorporate heavy metals as the main fungicidal agent. Many of these organic fungicides are specific against certain diseases and we hope that, in the not too distant future, a preparation will be formulated for efficient control of *Exobasidium vexans*. The preparations already tried out have been kindly supplied by manufacturers in the U.K. and U.S.A. where research on organic fungicides is being actively pursued.

The trials were of necessity on a small scale as many of the fungicides being in an experimental stage, were available only in very small quantities. The selected plots were all in one block and each treatment had 4-8 replications on a randomised basis. The total treatment in all cases covered 24 bushes. Perenox, a cuprous oxide fungicide, was selected as a standard against which the untried formulations were evaluated, while unprotected plots showed the infection level under the conditions in which the trials were conducted.

The rate of application was governed by the small hand spraying apparatus available, the actual volume being approximately 30 gallons to an acre. This application is about three times greater than that required for efficient protection with Perenox.

Before the trials were commenced the bushes were stripped of all blister susceptible material while spraying began immediately afterwards. The first pluck, in all cases, was discarded to avoid complications arising from infections on small buds prior to spraying operations. Normal plucking to a bud and two leaves was carried out on 10 day rounds.

For convenience in presentation, the results for the different materials tested are grouped together under the names of respective manufacturers —

(a) Messrs. E. I. du Pont de Nemours & Co.'s Dithiocarbamate fungicides (U.S.A.)

TABLE VII.

Percentage infected flush and banji.

Pluck			2nd	3rd	4th	5th
Unprotected			64	34	35	37
Fermate	1	lb/100 gallons water	63	33	25	27
,,	2	,, ,,	60	37	19	34
,,	4	,, ,,	57	32	21	22
Zerlate	1	lb/100 gallons water	60	28	20	19
,,	2	,, ,,	51	24	20	20
,,	4	,, ,,	53	24	10	9
Parzate	1	lb/100 gallons water	42	23	13	20
,,	2	,, ,,	54	29	8	15
,,	4	,, ,,	53	31	3	3
Control						
Perenox	2½	lbs/100 gallons water	7	2	3	0

TABLE VIII.

Average number of blisters on third leaf.

Pluck			2nd	3rd	4th
Unprotected			2.13	0.76	1.03
Fermate	1	lb/100 gallons water	2.10	0.87	0.76
,,	2	,, ,,	3.10	0.69	1.00
,,	4	,, ,,	1.09	0.79	0.28
Zerlate	1	lb/100 gallons water	1.76	1.20	0.73
,,	2	,, ,,	1.07	0.81	1.10
,,	4	,, ,,	1.17	0.44	0.92
Parzate	1	lb/100 gallons water	1.23	0.85	0.18
,,	2	,, ,,	1.77	0.64	0.12
,,	4	,, ,,	0.89	0.29	0.11
Control					
Perenox	2½	lb/100 gallons water	0.05	0	0

Fermate — (Ferric dimethyldithiocarbomate). No control even at application rates of 4 lbs. to 100 gallons of water.

Zerlate — (Zinc dimethyldithiocarbomate). Control ineffective though on the 4th and 5th plucks 4 lbs./100 gallons of water application showed a lighter degree of infection, when compared with the unprotected plots. In comparison with Perenox, however, control is relatively poor.

Parzate — (Zinc ethylene bis dithiocarbomate). Obviously the best of the three as far as blister blight is concerned. The high concentration of fungicide necessary for light control in comparison with Perenox makes it too expensive and uneconomic.

Rainfall previous to 2nd and 3rd plucks approximated to conditions under which protection is normally required. Results in inclement weather show that protection during those periods is extremely poor.

(b) Messrs. Rohm & Haas' Fungicides (U.S.A.)

TABLE IX.

Percentage infected flush and banji.

Pluck	2nd	3rd	4th	5th	6th	7th	8th
Unprotected	73	75	89	78	66	59	34
Arathane 1½ lbs/100 gals. water	72	60	59	78	54	53	29
Dithane ,, ,,	73	69	64	73	42	50	27
Control							
Perenox 2½ lbs/100 gals. water	13	8	16	11	2	9	7

TABLE X.

Average number of Blisters on third leaf.

Pluck	3rd	4th	5th	6th	7th
Unprotected	2.82	2.57	3.60	3. 4	2. 4
Arathane 1½ lbs/100 gals. water	2.78	1.72	1.85	3. 0	1. 3
Dithane ,, ,,	2.01	2.17	2.42	0.79	1. 2
Control					
Perenox 2½ lbs/100 gals. water	0.06	0.04	0.12	0.15	0.25

Arathane (Dinitrocapryl phenyl crotonate - CR1639) No Control.

Dithane (Zinc ethylene bis dithiocarbomate). The preparation is similar to Messrs. Du Pont de Nemours Parzate (See tables 7 & 8). At the concentration recommended by the manufacturers control is ineffective.

(c) Messrs. Bayer Products Limited (U.K.)

Proprietary fungicidal dust — Botrilex. A preparation containing a chloronitrobenzene. Application rate about 18 lbs. per acre. The dust caused an extensive yellowing effect on the leaves which, however, passed off with the advent of rain.

TABLE XI.

Percentage of infected flush and banji.

Pluck	2nd	3rd	4th	5th	6th	7th	8th
Unprotected	56	53	83	85	47	56	24
Botrilex	23	37	64	69	29	22	22
Control							
Perenox 2½ lbs/100 gals. water	5	3	4	6	1	6	2

TABLE XII.

Average number of blisters on third leaf.

Pluck	3rd	4th	5th	6th	7th
Unprotected	1.60	1.27	1.48	0. 9	1. 5
Botrilex	0.69	0.75	1.36	1. 2	0.79
Control					
Perenox 2½ lbs/100 gals. water	0.03	0.11	0	0	0

The degree of control is far too light for efficiency. The rate of application, as a dust, makes economic dusting improbable.

(d) Messrs. Plant Protection Limited (U.K.) Organic fungicides.

TABLE XIII.

Percentage infection flush and banji.

Pluck	2nd	3rd	4th	5th	6th	7th	8th
Unprotected	33	55	35	76	45	17	37
Shirlan AG ½ per cent	26	39	38	61	38	18	27
1 ,,	48	38	20	62	26	7	31
2 ,,	38	38	24	45	23	15	26
4 ,,	—	—	—	33	18	4	8
Control							
Perenox 2½ lbs/100 gals. water	5	7	8	14	6	0	3

TABLE XIV.

Average number of blisters on the third leaf.

Pluck	3rd	4th	5th	6th	7th
Unprotected	1.91	2.00	2.00	0.57	0.38
Shirlan AG ½ per cent	1.39	0.54	1.48	1.0	0.23
1 ,,	1.39	0.81	1.55	0.49	0.19
2 ,,	1.34	0.59	1.21	0.76	0.63
4 ,,	—	—	0.63	0.93	0.09
Control Perenox 2½ lbs/100 gals. water	0.13	0.03	0.10	0.10	0

Shirlan (50% salicylanilide strength). Very light control at 4% concentration, but even then far inferior to Perenox. Can never be of economic value.

TABLE XV.

Percentage infection of flush and banji.

Pluck	2nd	3rd	4th	5th	6th	7th
Unprotected	55	35	76	45	17	37
T.M.T.D. ½ per cent	48	22	51	16	22	22
1 ,,	34	12	35	9	3	12
2 ,,	28	11	28	7	2	4
4 ,,	20	7	18	7	1	2
Control Perenox 2½ lbs/100 gals. water	7	8	14	6	0	3

TABLE XVI.

Average number of blisters on third leaf.

Pluck	2nd	3rd	4th	5th	6th
Unprotected	1.91	2.00	2.00	0.57	0.38
T.M.T.D. ½ per cent	1.11	0.82	0.82	0.74	0.14
1 ,, ,,	0.66	0.33	0.38	0.25	0.11
2 ,, ,,	0.43	0.42	0.91	0.14	0.04
4 ,, ,,	0.43	0.13	0.43	0.05	0.17
Control Perenox 2½ lbs/100 gals. water	0.13	0.03	0.10	0.10	0

TMTD (Tetra methyl thiuram disulphide), showed a decided control above 1% concentration. At 4% concentration it appears as efficient as Perenox. The amount of TMTD required per acre at that strength is, however, extremely heavy — nearly 15 lbs. per acre is used compared with about ¼ lb. of Perenox.

(e) Messrs. Vitax Fertilisers Limited (U.K.) — Vitospor fungicide dust.

This preparation contains the following —

10 per cent copper oxychloride
1—5 per cent copper 8-quinolinolate
60 „ „ green sulphur
05-1 „ „ tricresyl phosphate, which it is stated gives the formulation greatly enhanced activity.

TABLE XVII.

Percentage of infected flush and banji.

Pluck	2nd	3rd	4th	5th	6th	7th	8th
Unprotected	81	73	67	60	25	68	39
Vitospor Dust	11	2	3	4	0	10	4
Control							
Perenox 2½ lbs/100 gals. water	16	3	3	4	0	4	0

TABLE XVIII.

Average number of blisters on third leaf.

Pluck	3rd	4th	5th	6th
Unprotected	2.3	2.6	1.20	1.10
Vitospor Dust	0.08	0.12	0.01	0.01
Control				
Perenox 2½ lbs/100 gallons water	0.06	0.03	0.02	0.07

Vitospor, as already stated, incorporates 10 per cent of copper oxycloride in its formulation. At the rate of application of 18 lbs. dust to an acre approximately 1,8 lbs. of copper oxychloride is deposited on the leaves. We know that ¼ lb. of Perenox will give effective control so the possibility remains that the copper oxychloride may be the controlling agent. We have now received a copper 8-quinolinolate formulation which does not incorporate the copper oxychloride and tests in the coming south west monsoon will give an answer as to whether the quinolinolate by itself will give the desired result. Vitospor in the United Kingdom costs approximately 60 cents a pound. Even at that price the fungicide used per acre will cost over Rs. 10 -, — without application costs — a figure too high for economic dusting.

(f) Messrs. Robinson Bros (U.K.) — Calcium thioglycollate formulation (wet spray).

TABLE - XIX.

Percentage infected flush and banji.

Pluck	2nd	3rd	4th
Unprotected	18	54	30
Calcium thioglycollate ½ per cent	8	24	15
Do 1 „ „	17	36	26
Do 2 „ „	12	42	24
Do 4 „ „	14	54	20
Control Perenox 2½ lbs/100 gallons water	2	1	1

To summarise, we have so far been unsuccessful in our attempts to find a suitable organic fungicide which will give adequate protection at an economic rate. Third leaf infections are a very important criterion of fungicide efficiency as a blister average of even 0.5, per third leaf, would increase the spore population in the air to such an enormous extent, that resulting infections could be very considerable. With normal plucking, the third leaf remains on the bush so that infections mature and so constitute a potential spore reservoir. A fungicide to be effective should be capable of keeping the blister average, per third leaf, below 0.1.

Copper spraying of tea in plucking.—In experiments on St. Coombs we have seen the decided advantage in the control of blister blight if tea in plucking is sprayed with a copper fungicide (Perenox). The experimental area which was pruned in December 1948 is divided into four blocks, each of which consists of three plots with the following treatments :— (a) Weekly sprayings, (b) fortnightly sprayings, (c) unprotected. A plot consists of two rows, each of 50 bushes. Two guard rows were allowed to grow up untouched as protection against spray drift between treatments.

The 4 replications of each treatment, therefore, gives an area of approximately one eighth of an acre. Plucking conformed to the normal estate practice of removing a bud and two leaves at nine day intervals. Spraying of the treated plots is done with a very fine nozzle which gives an approximate application range of 8-10 gallons to an acre, of a suspension of 4 ozs. Perenox in 10 gallons of water. Applications of the fungicide is made irrespective of weather conditions, spraying often being done during rain. When the experiment started on 23rd May, blister infection was nil following the long drought experienced in the early months of 1949. The advent of the monsoon on May 9th showed its effect on 24th June when flush infections were as follows —

Weekly sprayed plots — 7 per cent infected.

Fortnightly sprayed plots — 16 per cent infected.

Unprotected plots — 85 per cent infected.

There was, however, no appreciable loss in crop till the plucking on 23rd July from which time till the end of December the unsprayed plots showed diminished crop returns when compared with the sprayed areas.

TABLE XX.

Treatment	Crop harvested (expressed in pounds, dry weight per acre).	Percentage increase in crop.
Unprotected	82.20	—
Weekly sprayed	103.58	26
Fortnightly sprayed	102.50	25

The very slight difference in crop returns between the weekly and fortnightly applications suggest that under normal estate procedure fortnightly applications are sufficient.

A study of the following table of flush infections and blister incidence on the 3rd leaf (normally left on the bush) clearly demonstrates differences between the treatments.

TABLE XXI.

Percentage flush infections and blister incidence on third leaf of bushes in plucking

Plucking No.	Flush infections percentage of total flush			Average number of blisters on the third leaf		
	Weekly spray	Fortnightly spray	Unprotected	Weekly spray	Fortnightly spray	Unprotected
1	0	0	0	—	—	—
2	0	0.25	8.5	—	—	—
3	0.25	0.8	6.7	—	—	—
4	7.25	16.0	85.0	—	—	—
5	4.75	38.80	83.3	0.23	1.07	4.90
6	6.5	9.6	45.2	0.05	1.0	4.60
7	10.3	21.0	68.3	0.07	1.10	5.20
8	0.3	1.5	17.6	—	—	—
9	3.0	22.5	61.2	—	—	—
10	0.5	17.5	47.3	—	—	—
11	0.5	1.5	13.8	0	0.11	0.54
12	6.8	36.5	71.5	0.02	0.10	0.81
13	5.3	17.3	49.0	0.06	0.42	1.88
14	10.0	43.0	80.5	0.08	0.57	3.43
15	3.3	15.0	66.8	0.08	0.43	2.09
16	0.8	6.5	18.0	0.05	0.17	0.59
17	4.8	29.0	61.5	0.06	0.56	1.40
18	4.8	17.0	39.5	0.06	0.29	1.10
19	5.5	13.0	32.8	0.10	0.18	0.53
20	1.0	9.3	17.0	0.03	0.16	0.46
21	2.0	7.3	22.0	0.02	0.12	0.37
22	0.8	8.3	17.3	0.02	0.12	0.28
23	2.3	2.0	9.8	0	0.15	0.33
24	0	0.2	0.8	0.02	0.18	0.76

The blister incidence on the 3rd leaf gives a good indication of the number of blisters per bush and the potential spore production. Since one blister can produce millions of spores, spore formation can assume gigantic proportions if the incidence is over 0,5 per third leaf. When the blister incidence is between 3 and 5 per leaf unfavourable weather will cause heavy infections on flush and young stems.

This experiment will continue for a complete cycle at the end of which reliable data on the correlation between infections and epidemic attacks should become available and should indicate when spraying is desirable.

Spray Residues.

The amount of residue left by spraying with copper fungicides is being investigated by the Biochemistry Department.

Until more data are available estates should not under any circumstances spray tea in bearing.

STUDIES IN BLISTER BLIGHT CONTROL

III. A warning regarding the possible dangers attendant on the continued adoption of pruning into the dry weather as an agricultural control measure.

G. B. PORTSMOUTH

Up-to-date one of the most successful agricultural control measures against blister blight has been that of adjusting pruning programmes so that badly attacked fields are pruned at such a season that recovery takes place during the driest and most mist-free period of the year. This practice has now been almost universally adopted, on our recommendation, by most up-country estates which suffer severely from blister blight, with the result that, in most cases, bushes recovering from pruning are able to reach the tipping stage before blister blight infection builds up. This means that the bushes start their cycle with their initial canopy of maintenance foliage more or less intact and sufficiently mature to resist infection. Consequently, however, serious an attack may build up subsequently this initial canopy will remain unaffected and although crop may suffer the bushes themselves are unlikely to be seriously endangered.

Unfortunately pruning into the dry weather has itself a number of disadvantages from an agricultural standpoint. As a result of the general preoccupation with blister blight during the last few years it seems likely that many Superintendents may have tended to overlook the possible dangers attendant on the continued adoption of this practice. The question is one of particular importance at the present time since many fields will become due this season for their second pruning into the dry weather with the consequent likelihood of cumulative ill-effects reaching serious proportions. For this reason, therefore, it appears most advisable that the Superintendents of all *estates*

which are forced to prune into the dry weather, on account of serious and prolonged blister blight attack during the rest of the year, should be made fully aware of the attendant dangers and what practical steps may be taken to either minimise or overcome them.

The illeffects resulting from pruning into the dry weather are probably mainly ascribable to the following causes:—

(1) Direct Sun Scorch.

Exposure of horizontal branches to the direct rays of the sun for long continuous periods will cause intense heating of the upper surface which may bring about death of the bark and underlying cambium. These scorched patches of bark subsequently crack and permit entry of canker producing fungi. Drastic reduction of shade, such as has been carried out on many estates, will naturally accentuate this danger.

It seems probable that sun scorch is one of the principal factors responsible for bringing about the seriously cankered conditions of the St. Coombs No. 10 field, since this field is one that has been pruned continuously into the dry weather from its original planting. Furthermore, this field must have been relatively unshaded during its earlier years.

In order to reduce further damage from this cause it is suggested that all prunings should be piled back on top of the bushes and allowed to remain there for at least one month after pruning.

(2) Drought.

The effects of drought are sufficiently well known for further description to be unnecessary. However, it should be pointed out that bushes deprived of their leaves, as at pruning, are much less capable of extracting water from the soil than are bushes carrying a normal canopy of foliage. This is because the capillary pull in the vessels is destroyed with the result that an increased suction pressure has to be maintained in the roots if they are to succeed in obtaining water from the soil against the same external forces. Under drought condition, therefore, a pruned bush is likely to be capable of obtaining rather less of its water requirements from the soil than could an unpruned bush. Accordingly, the effects of drought are liable to be accentuated with pruned bushes and may be noticed in the dying back of branches from the pruning cut inwards.

The reduction in water extracting power of the pruned bush may also be expected to increase the effects of direct sun scorch, since damage from this cause is unlikely to occur if sufficient water is passing through the exposed branch.

The slowness of the recovery growth which occurs under drought conditions is, however, the factor likely to be of most immediate concern to the practical planter. Fields pruned into the dry weather may take as much as a month or more longer to reach the tipping stage, which entails the loss of a complete month's crop during the course of the cycle. This possible loss is, by itself alone, a very cogent reason for attempting to revert to our normal pruning programmes as soon as possible. In fact, a few of the least badly attacked estates have already done so, preferring to accept a possible loss of crop from blister blight rather than an almost certain loss due to delayed recovery.

(3) Forking.

Leaf-fall is normally forked in about one month to six weeks after pruning. At the present time much of this forking must be carried out during the dry weather with the result that the soil surface is broken up and the drying out of the soil and consequent danger of drought much increased.

The "Whirlwind Combination." A combined dusting and mist-blowing or wet spraying machine. If the liquid tank and pump unit is removed, the machine becomes a duster only.

Recommendations.

Unfortunately such precautions as can be suggested at present, can only be considered to go some way towards minimising these dangers. They certainly do not eliminate them in their entiety. The practical steps to be taken in this matter would appear to be as follows:—

(1) Protect pruned bushes from the direct sun by piling up prunings on top. Manna grass or jungle loppings can also be used for this purpose as has been the usual practice in N. India after a severe prune.

(2) Do not fork in pruning leaf if there is danger of drought ensuing.

(3) Stop any further drastic cutting out of shade trees. Shade should always be controlled, not eliminated. In this connection the type of canopy to aim at would appear to be a light feathery one which permits the penetration of broken up sunlight.

In conclusion it may be earnestly hoped that a successful outcome to our large scale spraying experiments on tea recovering from pruning will soon render it possible for estates to abandon pruning into the dry weather as a blister blight precaution and revert to their normal pre-blister blight programmes.

STUDIES IN BLISTER BLIGHT CONTROL

*PART IV. MECHANICAL DUSTING AGAINST BLISTER BLIGHT—SECTION 1.

H. DIKE

(Universal Crop Protection Ltd.)

Research into blister blight (*Exobasidium vexans*) on tea has demonstrated the fact that this disease cannot be controlled once the fungus has penetrated the plant tissue. From this it will be seen that it is necessary to protect the young susceptible leaf tissue in the early stages of its growth. It is well known amongst planters that up to the present time copper fungicides have given the most efficient control of fungoid diseases, of which blister blight is probably the most serious. Effective control of the disease, in the early stages, can be achieved by using a spraying mixture consisting of four ounces of copper oxychloride in 8—10 gallons of water per acre, and distributed by knapsack sprayer. This method of spraying is both slow and laborious. These two disadvantages can, however, be overcome by the use of mechanical means to apply and distribute the fungicide.

The most efficient, even, and economical means for distribution of fungicides is possible by using a machine of the "Whirlwind" series, (The "Whirlwind-sprayer-misblower"; the "Whirldwind Duster," or the "Whirlwind Combination", the latter being available for use as a sprayer, a duster or for wet-dusting).

Experiments in Ceylon.

Experiments were first made with a "Whirlwind Combination" sprayer, using copper oxychloride (Cuprokylt) solution, and copper-oil mixture (Cuproil) on Mattakelle Estate, and dusting experiments with the "Whirlwind Duster"

*The Institute does not necessarily endorse the views expressed in papers contributed by persons other than members of the staff.

using copper dust (Cuprosana) on Castlereagh Estate. It was seen, however, that after about six week's time, the dusting method appeared to be more efficient in the control of blister blight on Castlereagh Estate, and consequently a change was made on some of the plots on Mattakelle Estate, and it is for this reason the "Whirlwind Duster" is described in this article.

The name "Whirlwind" has primarily been given to this dusting machine, owing to the fact that the main feature is the production of a whirling air or cloud effect imparted to the dust upon being expelled from the machine nozzle. This cloud of whirling dust rolls over and through the tea bushes, and in its rolling gently deposits a fine coverage of fungicidal dust upon the surfaces of the tea leaves and stems both near to and distant from the machine.

It will have been observed that other dusters do not possess this special feature of producing a whirling cloud effect, but blow a straight blast or jet of dusting chemicals through the tea bushes, which leaves a heavy deposit of fungicide on the first few rows near the machine, whilst the more distant bushes may receive no dust at all.

The engine is a light compact air cooled, four stroke petrol driven engine, with oil-bath air cleaner. The fan of the generator is fixed directly on the motor shaft, forming "one" rotating unit which is superior to any other form of drive.

In the "Whirlwind" dusting machine agitators are not necessary to convey the dust from the hopper to the generator. The dust falls by its own weight into the air stream and is thus ultimately sucked into the generator.

The dust-hopper is capable of holding 100-140 lbs. weight of dust. The amount of dust discharged can be controlled by a lever from either side of the hopper at a rate varying from 0-35 lbs. per minute. The dusting can also be controlled by a change in the speed of the vehicle on which the duster is mounted.

The dust discharge takes place through the twin bend and outlet. This twin-bend-outlet-trunk consists of two parts, which rotate upon each other, and on the generator house. The component parts of the trunk are connected by special non-leak swivel joints, which permits the operator to rotate or turn the trunk in any desired position by the use of a direction-lever or ring. These features are highly important, owing to the fact that effective dusting must be carried out with the direction of the wind and, as the air currents are constantly changing, it will readily be seen that this mobility of the trunk is of the greatest consequence.

Experiments have shown that owing to the very small quantity of copper required for effective control of the disease, a specially prepared copper dust was necessary. This was manufactured and named "Cuprosana" dust. This particular dust has been proved to be most effective in the control of blister blight under all conditions of tropical weather.

The distribution of dust and the washing away by tropical rain, at varying distances from the point of application, have been investigated and compared in the field against other proved effective chemicals which were applied as sprays.

The results of the investigations were made possible by a rapid chemical micro-analysis for the determination of copper on tea leaves. The copper contents in the residues analysed are shown in Table I.

TABLE I.

Copper deposits remaining on leaves after spraying and dusting in the field.

	SPRAYING				DUSTING					
Distance from machine.	Heavy Cu p.p.m.	Moderate		Light	Heavy	Moderate Cu p.p.m.			Light	
25 ft.	2,349	1,130	593	172	4,175	2,716	967	508	245	149
1 day's rain	—	687	—	117	1,288	1,391	—	—	207	96
3 days' rain	1,425	586	250	99	690	469	268	178	181	59
125 ft.		251	83	—	362	232	181	169	148	141
1 day's rain		—	33	—	213	170	127	—	139	112
3 days' rain		162	—	—	113	—	66	51	127	51
200 ft.					361	195	122		135	
1 day's rain					103	77	67		49	
3 days' rain					84	101	66			
300 ft.					250				50	
3 days' rain					162				60	

These figures also demonstrate that the maximum working range of the spray is 125 feet, whilst that for the dust is considerably in excess of this figure.

As previously stated, it is a well known fact that with mechanical spraying and dusting the deposit on the leaves nearest the machine is generally heavier than that more remote.

Careful investigation has proved that heavy deposits of copper, both from spraying and dusting applications, are rapidly washed away leaving only a small basic level on the leaf for manufacture. Heavy roadside deposits can also be prevented when the dusting technique has been acquired by the operator. The following table demonstrates this.

TABLE II.

The range of copper deposits on flushes at various distances from the machine.

Distance from machine	Heavy Dusting. Cu p.p.m.		Moderate Dusting. Cu p.p.m.	Light Dusting. Cu p.p.m.
20-25 ft.	5,679	2,818	823	245
125-150 ft.	1,310	856	—	205
200 ft.	470	421	68	56
400 ft.	368	347	96	40

From a field, which was heavily dusted and uniformly covered to an approximate distance of 800 feet from the road on which the machine was operating, a number of flushes at varying distances in the field were selected for analysis with the following results. (Table III).

TABLE III.

The variation of the Cu. deposit on different leaves at various distances from the machine.

Distance.	Copper deposit in p.p.m.			
20-30 ft.	5,745	2,113	225	224
125-150 ft.	967	182	121	
200 ft.	251	83	77	
400 ft.	368	146	32	

After 5 days of rain and in bulk manufacturing of the tea this variation disappears.

It was proved in all experiments that, with skilled dusting technique and the diminishing of the copper content on the leaf in the period between application of the dust and plucking, the copper content in manufactured tea in bulk quantities was of a low order.

Note by Editor.

The necessity for rain between dusting and plucking to remove excess copper is emphasised. Moderate rainfall is sufficient to remove all excess dust and leave an active but unobjectionable deposit of copper.

STUDIES IN BLISTER BLIGHT CONTROL

*PART V. MECHANICAL DUSTING AGAINST BLISTER BLIGHT—SECTION 2.

H. DIKE

(Universal Crop Protection Ltd.)

"Cuprosana" dust is a highly effective fungicide, specially made for use with the "Whirlwind Duster," this combination of duster and dust providing the most efficient means for blister blight control on tea estates. For some time it was thought that wind and air currents would present very troublesome matters which would be very difficult to overcome, but by making intelligent use of these natural elements, and drawing up a wind current plan together with a map of the estate paths, it has been found that these wind currents can be of considerable use in improving the dusting range.

The "Whirlwind Duster," can, for purposes of use, be mounted on a jeep, trailer, small caterpillar, a three or four wheel trolley or carried by four coolies. During the dusting operation it is advisable to have a "spotter" to observe that sufficient coverage is being made by dust on the tea bushes. If the deposit is seen by the "spotter" to be insufficient from any cause, it is possible to inform the operator who can rectify this deficiency. It may also be found that a specified plot is difficult to dust every day at a particular time, owing to adverse wind currents, generally it is noticeable that at certain hours of the day, this adverse wind is either not blowing or in a favourable direction for the dusting to be proceeded with. By making notes of these matters it is possible to draw up a wind draft or wind current plan, which will save time and enable the dusting operator to make a uniform and even coverage.

*The Institute does not necessarily endorse the views expressed in papers contributed by persons other than members of the staff.

On sunny days rising air currents may sometimes cause the loss of a small percentage of the chemical dust employed. Dusting in misty weather, drizzles or slight showers is found to be most favourable and effective, owing to reduced drift and to the copper particles being well dispersed over the leaf surface immediately after the setting of the dust on the wet foliage. Weather records were kept during the monsoon period, and it was observed that at least four hours each day were favourable for dusting. The advantage of working with a machine having a capacity of 30-40 acres per hour is that the superintendent can select the best time to assure a good coverage of the tea bushes. The economical aspect is the saving in wages, as during very wet periods only a few men are idle compared with more than a hundred men when knapsack sprayers are used, whilst the capacity of the machine still enables the labourer to perform the daily task. In this connection the influence of heavy rains on dusting in operation was investigated. When dusting was carried out in torrential rain, the drifting dust could not be "spotted" in the downpour. After several showers, six hours later, analyses were made to ascertain the copper deposit and dispersal over the leaf surface. These analyses showed that the copper or the dust had immediately dispersed in the rain over the leaf surface in an even distribution and was still available. Some typical figures are given below :—

Distance from Machine.	Cu p.p.m.	Cu p.p.m.
100 feet	217	227
200 feet	157	204
300 feet	102	154

Thousands of analyses were made, from which data were obtained regarding the range, drifting, deposits after heavy, moderate and light dusting and the copper contents in the residues immediately after dusting and just prior to plucking. However, one of the most important questions still to be answered was, "What is the minimum amount of copper required in the residue to give efficient control of blister blight in the field?" The answer to this question was given by the dusting results on plot No. 1 on Castlereagh Estate. This was a plot at an altitude of 3,600 feet six months from pruning, situated in a damp hollow which contained a number of streams, had little air movement, and was thus very susceptible to blister blight.

An endeavour was made to dust this plot with a uniform and even distribution of 7-9 lbs. per acre of "Cuprosana 2" a 2 per cent copper dust, but owing to adverse wind currents at times, the dusting was found to form sometimes a heavier cover on the leaves in some places than in others. Bearing this in mind, and knowing that these heavy deposits are washed away by rain, the practice of plucking the leaf just before dusting was adopted, which left the tested fields exposed to rain for six days following the application of the dust. A check was made by picking at random a number of flushes from the total pluckings of the treated area. These were analysed, and showed that the copper content on the leaves varied from 20—380 p.p.m. The average for the leaves analysed was 60 p.p.m. Similarly the manufactured tea was also tested and showed a copper content of 60 p.p.m.

The monsoon had broken about the 25th of May, but the first dusting was not commenced until June the 5th by which time spores of the fungus had already germinated and unfortunately gained entry into the leaves. After six weeks of dusting definite visual results were to be seen in the very much larger amount of young flush making its appearance. Counts of flush infections from dusted and undusted areas were made to ascertain the percentage of infected leaves. On the undusted areas, not only was there a high percentage of stem infections, but very young flushes failed to mature if infected at an early stage, as they shrivelled up and turned black. A still more detrimental form of local infection is the bud-infection which blackens and destroys one

generation of buds after the other and leaves the bushes completely defoliated. In the dusted areas most of the buds commenced to grow and bushes reached a pluckable stage. Although a certain number of leaves showed signs of very light infection (translucent spots) these were nearly all plucked before reaching the blister stage and thus were not a source of danger for further infection. In these areas there is a considerable amount of young and vigorously growing susceptible leaf tissues, whilst much of this growth in undusted areas is blackened and so may never be included in any count or reckoning, from which it will be evident that infection counts between dusted and undusted bushes are not a satisfactory means of arriving at precise figures. A more reliable method of obtaining results can however be obtained by combining infection counts and plucking weights.

The plucking weight method, although not exact, as it may be influenced by factors such as better yield due to sheltered conditions, or otherwise in wind swept areas, was definitely in favour of the dusted areas.

The amount of dust required is 7-10 lbs. per acre. The price of "Cuprosana 2" is circa Rs. 0.27 per pound weight, therefore the cost per acre for weekly dusting rounds would be less than about Rs. 2,38 (dust) + Rs. 0.12 (labour) = Rs. 2.50.*

TABLE IV.

Yields, costs and blister blight infections in fields 6 — 34 months from pruning.

Time from Pruning	6 months		8 months		20 months		30 months		34 months	
	Dust	No. D	Dust	No. D	Dust	No. D	Dust	No. D	Dust	No. D
10th July	95	56	—	—	mist belt		—	—	—	—
	92	54	86	57	—	—	—	—	—	—
Yield of green leaf	100	58	56	38	48	16	67	36	45	36
in lbs. per acre.	97	66	64	53	31	11	88	54	52	50
	150	80	80	61	39	28	91	50	50	44
	90	68	70	59	28	25	60	47	48	47
	93	71	80	77	43	25	—	—	—	—
30th of August	103	72	—	—	—	—	—	—	—	—
	820	525	436	345	189	105	306	187	195	177
Increase in yield in lbs. per acre	295		91		84		119		18	
Increase manuf. tea in lbs. per acre approx.	74		23		21		30		4,5	
Price tea at Rs. 2/30 per lb. Financial increase in Rs. p. acre	185/-		57/50		52/50		75/-		11/25	
Dusting rounds	13		11		10		9		9	
Cost of dusting Rs. p. acre	32/50		27/50		25/-		22/50		22/50	
Financial gain in Rs. p. acre	152/50		30/-		27/50		52/50		11/25	
Stem infections	—	4	—	5	1	5	—	—	—	—
Old active blisters	—	1	1	6	3	13	—	—	—	—
Old brown blisters	—	1	1	12	6	8	—	—	—	—
Flush infections	2	18	18	30	31	57	—	—	—	—
Total infections	2	24	20	53	41	84	—	—	—	—

*Note by Editor: Large scale trials have when costed given a higher figure.

From this table the following conclusions are drawn — Dusting of tea one and two years from pruning is definitely highly desirable and economically justified. Dusting of tea three years from pruning may not be economical, but the bushes which have been dusted are absolutely free from flush, stem and bud infection, have a healthy appearance and are able to build up sufficient starch reserves for the next pruning.

Whilst weekly dusting has given a certain proportion of control, the frequency of seven days does not appear to be sufficiently effective on new fields. It is probable that rounds of five or six days will be required for effective control.

For a field three years from pruning, where the rate of growth is not so rapid, a ten day dusting period may be sufficient to control defoliation and destruction of buds, by which means the health of the bush can be maintained, and death after pruning due to lack of starch prevented.

Areas pruned in June may require a four day dusting round up to tipping time.

Disadvantages and advantages of the Dusting Method.

There are only a few disadvantages to the dusting method, and fortunately they can be overcome. The most persistent difficulty is the copper content in the manufactured tea, but when the superintendent can develop his plucking-dusting plan, and the operator works intelligently by improving his practical knowledge and skill in using wind drifts to distribute the powder evenly at long range, the copper content can easily be checked, and kept below the stipulated tolerance figure.

From personal experience it is apparent that some of the local labourers show interest in dusting by the "Whirlwind Duster" and are surprisingly quick in mastering a perfect dusting technique.

Official tests of manufactured tea from our experiments have shown no tainting, no excess of copper, and an excellent quality of tea.

Advantages.

1. The construction of the machine is simple, no wear and tear.
2. The duster is light in weight and very easy in handling.
3. The very long working range (200 — 800 feet) reduces running tracks to a minimum. Any spot on the estate can be covered as the duster can be mounted on a lorry, jeep, trailer, small caterpillar, trolley or can be carried by coolies.
4. The twinbend with swivel-joints makes the outlet completely adjustable to follow the slighest change in the wind-direction.
5. The whirling in the rolling cloud guarantees an even coverage. Minimum amounts of copper only are required, but the particles must be very fine and highly soluble, as is achieved in the manufacture of "Cuprosana Dust".
6. The dusting capacity of at least 30 acres per hour allows of operations at favourable moments, and permits shorter dusting rounds, should these be required.
7. The saving in labour is great. Four to six men being able to cover the same area for which 100-120 men are required with knapsack spraying.
8. No water is required in connection with the application, which eliminates water haulage. It also reduces the risk of spore germination in an already humid atmospheric condition, which is highly favourable for spore germination. Further water assists the run-off of sprays from wet leaf surfaces.

9. The dust particles are carried by the prevailing wind currents and settle on the same places where the airborne spores are being deposited.
10. The application costs for the dusting are the same as for knapsack spraying, but may become lower in future.
11. The initial capital outlay for the machine is 25 per cent of that for knapsack spraying equipment required to cover the same area.
12. The increase in yield makes dusting applications economically justified.
13. The dusting method may provide an opportunity to return to the normal pruning time.
14. Bushes frequently suffering from defoliation will not stand up to pruning and death of the bushes after pruning may result. The financial loss by deterioration and death of bushes would be considerably heavier than the loss of the crop. It has been definitely proved that dusting considerably reduces bud and stem infections and in turn defoliation and deterioration.

Throughout the whole of our tour, every facility was afforded to study the organisation, methods and technique adopted on tea estates in Ceylon, whilst our stay on the Island was made happy and comfortable by lavish hospitality which was greatly appreciated, and for which we tender our sincerest thanks to :—

J. Lamb, Esq., Director, Tea Research Institute of Ceylon, St. Coombs, Ceylon, for his co-operation, help, assistance and discussion of problems.

G. B. Portsmouth, Esq., and all the members of the Staff who so kindly assisted and co-operated in every way. Also to Messrs. Harrisons & Crosfield, Ltd., Colombo, for making arrangements, organising and other efforts to ensure success.

The Directors of Castlereagh Tea Company, Ltd. and the Directors of the United Planters Co. of Ceylon, Ltd., for making facilities to carry out the tests on their respective estates.

J. G. Baker, Esq., Superintendent of Castlereagh Estate, for his personal attention, enthusiasm and activity in the matter.

J. Macmahon, Esq., Superintendent of Mattakelle Estate, and P. S. M Molyneaux, Esq., Superintendent, Talawakelle Estate, for their assistance in carrying out the tests.

Again we wish to express our thanks and gratitude to all the ladies and gentlemen who have so ably contributed towards our researches and studies, by placing valuable information at our disposal, and for the many kindnesses extended towards us.

THE EFFECT OF MANURE ON THE ROOTING OF INTERNODE CUTTINGS.

By F. H. KEHL.

The soil is the essential medium for growing plants. Some soils are weak in potential resources but these can be supplemented by the addition of organic or inorganic fertilisers.

In tea nurseries, where plants have been raised year after year, manuring of some sort is carried out for it is an accepted axiom that plants grow more vigorously when organic matter has been incorporated into the soil. Seedlings are often dosed with frequent applications of liquid manure and the results have been that plants grew more luxuriantly.

Since the Institute began Vegetative Propagation on a large scale the process of applying liquid manure to rooted cuttings, at fortnightly intervals, has been carried out for many years. These experiments have proved that this process has made a definite contribution towards the more luxuriant growth of the plants but has tended towards a steady decrease in the rooting percentages of all clones.

The following experiment was therefore designed to determine whether cuttings rooted better in manured or unmanured soils

Details of the experiment.

An area that had never been manured was selected and four beds were made. Soil was removed to a depth of 18 ins. one half of each bed was filled with unmanured soil and the other with soil from the main vegetative propagation nursery, that had been manured at regular intervals. Both sets of soil were passed through a No. 4 mesh sieve. Other relevant details regarding this experiment are included in Table I.

TABLE I.

		Manured.	Unmanured.
Soil Type	...	Black loam.	Red loam.
ph.	...	5.4	5.4
Eelworm	...	None found	None found
Clone	...	777	777
Type of cutting	...	Green single node.	Green single node.
Planted	...	11.11.49.	11.11.49.
Examined	...	24. 5.50.	24. 5.50.

Results

These are given in Table II below :—

TABLE II.

Total Rooted.

		Manured	Unmanured
Bed 1	...	34	88
2	...	24	78
3	...	41	76
4	...	39	110
Total	...	138	352
Mean	...	34.5	88.0

Little need be said about these figures which are statistically significant. In every bed the rooting in the unmanured plots has been over twice as much as the manured. It is, therefore, quite obvious that cuttings will root very satisfactorily in poor soils of good texture, provided they are properly handled as to water and shade.

Once cuttings have rooted in poor soils, the next problem is to maintain them in a healthy and vigorous condition without using manure. The following alternative methods are suggested for consideration :—

(1) Rooted cuttings from unmanured beds can be transferred to favourable sites. The snag about this method is that there is bound to be a certain amount of root damage resulting in a set back to the plants.

(2) Nurseries that have already received frequent applications of manure could be rested for some time.

(3) The top 4 ins. to 6 in. of regularly manured beds could be made up with soil that is not rich in organic matter.

*THE MECHANICAL PLUCKING OF TEA

B. D. FAY

(Dickwella Estate, Haliela)

(Received 11th May, 1950).

Introduction.

The experiments on the mechanical plucking of tea as carried out by me here on Dickwella Estate, Hali-Ela, with the Tarpen Cropper with advice and assistance from the Tea Research Institute of Ceylon have, I think, created some controversy and enough interest to justify a review of my work to-date.

Dickwella, near Badulla in the Uva Province of Ceylon, lies in hilly country between 2,000, to 4,000 feet, where rainfall is low and annual droughts coupled with high wind in the S.W. monsoon are a normal occurrence.

Before proceeding, I have to record the Tarpen Engineering Company's and my grateful thanks to the Directors of the Dickwella Tea Company, Ltd., and Messrs. Whittall & Company, Colombo, for kindly permitting us to carry out the experiments, and also to the numerous officers of the Tea Research Institute for their readily offered and gratefully accepted guidance, assistance and encouragement in the work involved. I have also to thank the Assistants and the members of the estate staff here who readily co-operated in the work, at the expense of their leisure.

Machines.

The Tarpen Cropper is too well known to call for repetition of its description here, except to report that a new system of power transmission has been evolved by which the cropper is driven by a flexible drive powered by a fractional H.P. motor. This motor is carried on the operator's back. The original electric model is supplied with power from a portable generator through long flexes or cables These cables are hauled through the tea by the operator as he works up a row, and drawn back to the road by another labourer as required. Although this system appears cumbersome it is not so in actual use.

Mr. H. M. O'Connor of the New Dooras Tea Estates, Dooras District, S. India, has ably demonstrated that the Jeep will afford further mobility to the electric model. However, the new flexible drive or knapsack model should give complete freedom of operation and prove particularly useful in contour planted areas.

A possible refinement in the use of the electric model has been suggested by Mr. C. J. Harrison of the Indian Tea Association Experimental Station at Tocklai, Assam. It is however restricted to flat land which, unfortunately, is not available in Ceylon tea districts. The method requires a light frame mounted on wheels and high enough to straddle one row of bushes. This frame would carry the generator and also a light cross arm. The cross arm would bear six or eight equally spread power plugs. The croppers could then be plugged into the points on the cross arm and the whole unit pushed along the row at the rate required by those operating the croppers. The wheels could be mounted on the same way as castors for.

* The Institute does not necessarily endorse the views expressed in papers contributed by persons other than members of the staff.

Fig. 1. Mechanical Plucker in action.

Figs. 2. General view of mechanical plucking showing battery of pluckers and generator.

Experiments.

Dr. T. Eden, late of the Tea Research Institute, organised the field experiments on Dickwella. The main aims of the experiments are —

1. To compare the cropping capacity of the bushes plucked by hand and by mechanical means both with regard to total crop, and to the distribution of crop within the season and the pruning cycle.

2. To compare the quality of tea made from each source.

Two units were laid down, with adequate randomized replication and they are known as Units 1 and 2, each of 6,000 and 8,000 productive bushes respectively, half of which are hand and half machine plucked.

I myself put a third Unit or block of tea of some 9 to 10 acres under mechanical plucking with a view to using this Unit as a school for labour, a demonstration plot, and also to yield data on break-downs, fuel consumption, the reactions of the equipment to weather, costs, etc.

It is relevant to point out here that the 3 units are widely dispersed over the estate, they were all three, pruned, tipped and brought into hand or mechanical plucking at approximately the same time (about two years ago) and in the case of Units Nos. 1 and 2, the machines are pitted against the best hand pluckers. Further, no special pruning or manurial preparation of the Units has been done before or since the start of the experiments. The system of pruning and manuring most suitable to mechanical plucking has yet to be investigated.

Unit No. 1.—This unit is divided into 30 blocks, half of which are hand and half machine plucked. Harvesting by both methods is done on the same day at set 10 day or average 10 day intervals, irrespective of growth or any other factor, and all yields carefully recorded.

The first cropping or harvesting took place on the 9th of August, 1948, four months after pruning and two months after tipping, since when 63 pluckings have been done up to the 22nd April 1950 — a period of 621 days. The aggregate yield in the mechanically plucked blocks is 6,397 lbs. of green leaf against 6,227 lbs. from the hand plucked blocks in the same Unit. This Unit, as well as the other two, has another year to run before the end of the experiment at the completion of a 3 year pruning cycle. Table I, reproduced below, shows the result of each individual pluck and the yields obtained are in direct contradiction to those found by Mr. N. Kanagaratnam in Malaya (1).

TABLE I.

Unit No. 1. (Average 10 Day Rounds).

Yield of Green Leaf in pounds.

Date of Pluck.	Yield per pluck		Cumulative Total	
	Machine.	Hand.	Machine.	Hand.
9. 8.48	116.4	179.5	116.4	179.5
19. 8.48	93.6	115.0	210.0	294.5
30. 8.48	84.7	120.4	294.7	414.9
9. 9.48	68.2	78.3	362.9	493.2
18. 9.48	69.7	76.8	432.6	570.0
29. 9.48	55.9	65.1	488.5	635.1
9.10.48	51.3	42.1	539.8	677.2
20.10.48	52.2	50.5	592.0	727.7
29.10.48	65.7	63.3	657.7	791.0
8.11.48	168.7	135.1	826.4	926.1
18.11.48	104.7	128.1	931.1	1,054.2
27.11.48	118.6	107.0	1,049.7	1,161.2

TABLE I.—(Continued).

Unit No. 1. (Average 10 Day Rounds).

Yield of Green Leaf in pounds.

Date of Pluck.	Yield per pluck		Cumulative Total	
	Machine.	Hand.	Machine	Hand.
8.12.48	77.1	96.7	1,126.8	1,257.9
18.12.48	88.5	75.4	1,215.3	1,333.3
28.12.48	103.6	107.3	1,318.9	1,440.6
7. 1.49	103.3	110.3	1,422.2	1,550.9
17. 1.49	54.9	63.4	1,477.1	1,614.3
27. 1.49	52.6	48.7	1,529.7	1,663.0
5. 2.49	40.5	45.8	1,570.2	1,708.8
17. 2.49	49.5	54.3	1,619.7	1,763.1
26. 2.49	89.3	83.2	1,709.0	1,846.3
8. 3.49	127.4	127.4	1,836.4	1,973.7
18. 3.49	99.1	92.1	1,935.5	2,065.8
28. 3.49	95.2	81.2	2,030.7	2,147.0
6. 4.49	87.7	65.7	2,118.4	2,212.7
16. 4.49	110.2	84.4	2,228.6	2,297.1
26. 4.49	180.0	144.4	2,408.6	2,441.5
6. 5.49	165.5	151.9	2,574.1	2.593.4
16. 5.49	133.6	127.4	2,707.7	2,720.8
26. 5.49	88.3	79.9	2.796.0	2,800.7
6. 6.49	103.1	94.7	2,899.1	2,895.4
16. 6.49	80.9	87.2	2,980.0	2,982.6
25. 6.49	72.9	88.1	3,052.9	3,070.7
5. 7.49	56.7	57.0	3,109.6	3,127.7
15. 7.49	43.0	44.7	3,152.6	3,172.4
25. 7.49	42.6	38.4	3,195.2	3,210.8
4. 8.49	60.0	65.9	3,255.2	3,276.7
15. 8.49	93.7	109.3	3,348.9	3,386.0
25. 8.49	116.2	117.6	3,465.1	3,503.6
5. 9.49	123.4	132.9	3,588.5	3,636.5
15. 9.49	115.3	114.2	3,703.8	3,750.7
24. 9.49	115.1	121.7	3,818.9	3,872.4
4.10.49	134.5	137.8	3,953.4	4,010.2
14.10.49	114.7	116.8	4,068.1	4,127.0
24.10.49	124.0	128.6	4,192.1	4,255.6
4.11.49	180.0	171.9	4,372.1	4,427.5
14.11.49	152.3	138.5	4,524.4	4,566.0
23.11.49	131.9	107.7	4,656.3	4,673.7
3.12.49	141.4	126.9	4,797.7	4,800.6
13.12.49	120.5	108.8	4.918.2	4.909.4
23.12.49	174.0	132.9	5,092.2	5i042.3
2. 1.50	82.2	61.8	5,174.4	5,104.1
12. 1.50	37.8	42.6	5,212.2	5,146.7
23. 1.50	59.7	44.8	5,271.9	5,191.5
1. 2.50	63.4	48.7	5,335.3	5,240.2
11. 2.50	94.5	81.6	5,429.8	5,321.8
23. 2.50	171.0	159.7	5,600.8	5,481.5
3. 3.50	167.6	156.9	5,768.4	5,638.4
13. 3.50	107.5	107.7	5,875.9	5,746.1
23. 3.50	120.5	110,5	5,996.4	5,856.6
1. 4.50	117.7	103.3	6.114.1	5,959.9
10. 4.50	124.8	117.5	6,238.9	6,077.4
22. 4.50	158.3	149.7	6,397.2	6,227.1

Unit No. 2.—The layout and treatment of this Unit is identical to Unit No. 1 except that it contains more tea bushes (8,000) and hence more blocks (40 in all) and a slight variation in the randomized replication has been applied. The aim in this Unit is to record the yield when crop is taken by hand or machine as and when either is judged ready.

It was easy to assess the readiness of the hand plucked blocks but my judgment as to when the machine plucked blocks were ready for harvesting was evidently seriously at fault and remained so until Mr. G. B. Portsmouth of the Tea Research Institute kindly made an appreciation of the situation and advised a drastic elongation of the rounds over the mechanical plucked blocks in this Unit. This gave immediate and phenomenal results in increased crops but again the human factor came into fault through too close cropping and yields started to fall off once more. Since then an improvement to the cropper, suggested by Mr. F. C. Daniel of St. Coombs (the Tea Research Institute Station) has been used automatically to control cropping levels.

The table of yields from this Unit appears below (Table II), and while it reflects the errors that occurred it also stresses the ignorance with regard to a *modus operandi* for mechanical plucking. This table together with that for Unit No. 1 also emphasises the fallacy of drawing dogmatic conclusions after a few weeks or even months experimentation.

TABLE II.

Unit No. 2. (Plucked when ready).

Yield of Green Leaf in ounces.

Date of Pluck.	Yield per pluck		Cumulative Total	
	Machine.	Hand.	Machine.	Hand.
10. 8.48	123.8	172.9	123.8	172.9
20. 8.48	110.6	172.4	234.4	345.3
27. 8.48	84.1	106.7	318.5	452.0
6. 9.48	91.8	119.0	410.3	571.0
15. 9.48	94.8	111.2	505.1	682.2
23. 9.48	90.5	135.2	595.6	817.4
2.10.48	81.6	121.6	677.2	939.0
11.10.48	131.7	150.0	808.9	1,089.0
19.10.48	117.6	118.5	926.5	1,207.5
28.10.48	116.5	112.6	1,043.0	1,320.1
5.11.48	150.8	147.0	1,193.8	1,467.1
12.11.48	122.9	149.8	1,316.7	1,616.9
22.11.48	148.3	153.5	1,465.0	1,770.4
30.11.48	145.0	147.6	1,610.0	1,918.0
9.12.48	130.7	178.2	1,740.7	2,096.2
20.12.48	124.3	112.9	1,865.0	2,209.1
30.12.48	98.4	122.3	1,963.4	2,331.4
11. 1.49	75.0	71.9	2,038.4	2,403.3
21. 1.49	8.6	11.4	2,047.0	2,414.7
31. 1.49	28.0	35.7	2,075.0	2,450.4
9. 2.49	69.3	87.5	2,144.3	2,537.9
19. 2.49	217.5	235.1	2,361.8	2,773.0
28.2.49	161.5	170.6	2,523.3	2,943.6
7. 3.49	220.9	216.3	2,744.2	3,159.9
15. 3.49	178.8	179.2	2,923.0	3,339.1
25. 3.49	124.4	127.6	3,047.4	3,466.7
2. 4.49	102.6	105.2	3,150.0	3,571.9
11. 4.49	150.4	166.1	3,300.4	3,738.0
20. 4.49	205.6	169.8	3,506.0	3,907.8
28. 4.49	273.5	288.1	3,779.5	4,195.9

TABLE II.—(Continued).

Unit No. 2. (Plucked when ready).

Yield of Green Leaf in ounces.

Date of Pluck.	Yield per pluck.		Cumulative Total	
	Machine.	Hand.	Machine	Hand.
7. 5.49	239.5	208.1	4,019.0	4,404.0
17. 5.49	222.7	190.0	4,241.7	4,594.0
25. 5.49	152.7	229.6	4,394.4	4,823.6
3. 6.49	136.8	198.6	4,531.2	5,022.2
11. 6.49	202.0	264.4	4,733.2	5,286.6
21. 6.49	197.0	223.7	4,930.2	5,510.3
1. 7.49	92.6	128.2	5,022.8	5,638.5
11. 7.49	87.8	135.6	5,110.6	5,774.1
22. 7.49	168.2	150.5	5,278.8	5,924.6
1. 8.49	140.9	146.8	5,419.7	6,071.4
11. 8.49	138.5	163.9	5,558.2	6,235.3
20. 8.49	152.2	181.1	5,710.4	6,416.4
30. 8.49	285.6	296.8	5,996.0	6,713.2
9. 9.49	169.6	175.6	6,165.6	6,888.8
19. 9.49	202.0	189.7	6,367.6	7,078.5
30. 9.49	137.7	159.8	6,505.3	7,238.3
10.10.49	160.5	157.3	6,665.8	7,395.6
20.10.49	—	229.6	—	7,625.2
31.10.49	770.0	225.0	7,435.8	7,850.2
11.11.49	—	153.5	—	8,003.7
24.11.49	240.3	158.8	7,676.1	8,162.5
6.12.49	—	98.4	—	8,260.9
16.12.49	—	181.4	—	8,442.3
17.12.49	273.7	—	7,949.8	—
29.12.49	—	116.6	—	8,558.9
9. 1.50	177.4	—	8,127.2	—
13. 1.50	—	58.1	—	8,617.0
26. 1.50	—	52.1	—	8,669.1
30. 1.50	53.7	—	8,180.9	—
2. 2.50	—	54.8		8,723.9
14. 2.50	228.4	210.1	8,409.3	8,934.0
24. 2.50	—	356.9	—	9,290.9
1. 3.50	615.3	—	9,024.6	—
10. 3.50	—	594.0	—	9,884.9
18. 3.50	244.6	168.0	9,269.2	10,052.9
28. 3.50	—	328.8	—	10,381.7
5. 4.50	262.0	—	9,531.2	—
7. 4.50	—	232.0	—	10,613.7
18. 4.50	299.6	356.4	9,830.8	10,970.1

Unit No. 3.—This is a 9 to 10 acre block of tea, chosen by me for its variable terrain, on which to essay answers to the questions posed above. No scientific control appeared possible nor was any attempted, though the figures quoted are actual ones taken from the records.

It was evident very early on that it would be advisable to have as many labourers as possible familiar with Mechanical Plucking to dispel any illusions about the skill required in operation. The ease with which any ordinary male Tamil labourer adapted himself to the job soon overcame this possible defect.

As a demonstration plot, the area fully justified itself. The extraordinary improvement in the spread of the bushes and the high multiplication of the plucking points per bush are immediately obvious to anyone familiar with tea.

The plot also proved that the machines are mechanically sound. They have worked at 3,500 feet elevation in a battery of six, with no major breakdowns, except some teething troubles with the armatures in the cropping motors, in all kinds of weather from drought to torrential rain.

Before going into detail of costs it is necessary to stress the following — 1. Mechanical plucking enables harvesting to be done very much less frequently than hand plucking. At the present time the optimal frequency would appear to be about half that of hand plucking. The whole question, however, still requires much further investigation,

2. One cropper or two labourers can harvest between 3/4 to 1¼ acres of tea per 8 hour day.

Costs are so intimately related to the preparation of the bush from and including pruning, and the amount of crop on offer, that it is impossible to dogmatize at this stage. However, the following comparative figures of cost per acre and per pound of made tea together with actual harvesting figures are of interest and do, I think, establish the possibility of very substantial savings being inherent in mechanical plucking. It must be remembered that the mechanical plucking costs include work done by untrained labour, over unprepared bushes, as well as numerous adaptions in method as and when thought advisable.

Comparative Costs inclusive of Dearness Allowance but excluding depreciation.

	Per Acre.		Per Pound.	
	Machine.	Hand.	Machine.	Hand.
January 1950 (Low Crop)	Rs. 3/50	Rs. 2/78	Cts. 78.03	50.42
March 1950 (High Crop)	Rs. 5/68	Rs. 8/94	Cts. 14.57	21.77

Actual harvesting figures (green leaf) from the last three mechanical plucks of — Unit 3.

Date.	No. of Coolies.	Hours worked.	Green Leaf lbs.	Average per hour per cooly.
24/3 — 25/3/50	* 12½	250	2,300	9.2
11/4 — 12/4/50	* 13	266½	2,570	9.7
28/4— 3/5/50	* 13	351½	3,560	10.0
Total	38½	868	8,430	9.7

* Including sack cooly.

	No.	MACHINES.		Avg. p. hour p. machine.
24/3 — 25/3/50	6	120	2,300	19.1
11/4 — 12/4/50	6	123	2,570	20.9
28/4 — 3/5/50	6	105	3,560	34.0
Total	18	348	8,430	24.2

The maximum crew required to operate electrically powered croppers is 2 labourers each, whereas a maximum of only 1.5 labourers per machine will be necessary to operate the "knapsack," self powered model with the added advantage of complete freedom of operation in the latter.

Manufacture.

In the early stages of my work (18 months ago) rigorously controlled experiments, on the manufacture of machine and hand plucked leaf gave a broad answer to the question of quality, at any rate sufficiently good to allay any fears of a marked deterioration in quality. Although standards of appearance declined, the results justified the continuation of the experiments.

Since then no further manufacturing experiments have been carried out until very recently when one was carried out to investigate the effect of an abnormally lengthy round on mechanically harvested leaf.

Unit No. 2 was plucked on the same day by hand and machine with the difference that the hand leaf was only 8 days old whereas the machine leaf was 17 days old. The samples drew a mixed reception, some tasters giving considerable preference to the hand plucked teas, others finding no difference whatever, except with regard to appearance which was rated inferior to the standard of hand plucking.

Social Repercussions.

It has been suggested that mechanical plucking of tea, when proved and generally adopted, will give rise to undue or mass unemployment. Such an outlook is reactionary to say the least, and similar to that of the opponents of the mechanization of the cotton trade in the last century. Such an attitude is incompatible with progress and the provision of better living conditions for tea estate labour.

Summary and Conclusions.

Machines.—It is obvious that such an adaption as mounting the generator on a Jeep or mobile frame, as envisaged above, will give full mobility to the electric models, though the aim is already accomplished by manhandling the generators, cables and machines as required.

Powering of the cropper by a light engine carried by the operator will give complete freedom of movement but has yet to be tested under field conditions.

Field Trials.—Data from Units 1, 2 and 3 prove that so far there is no danger of loss of crop and indicate a possible increase in yield. Over and above this, the market improvement in spread of the bushes gives the added benefits of increased plucking points and complete soil cover, thus reducing erosion and weed growth to a minimum.

Manufacture.—Here too there appear to be no ground to fear deterioration of the finished product except perhaps in appearance. Further knowledge of cropping procedure and improved coarse leaf extractors should overcome any defect in appearance. Also the fact that leaf is untouched by hand from bush to lofts is a great advantage.

Cost.—This will be the deciding factor where ample skilled labour is available but strong indications of substantial savings are apparent even where the machines are pitted against very efficient pluckers, as in Ceylon. In countries short of labour their advantage needs no emphasis.

Labour.—The mechanization of tea plucking is such a revolutionary process that it cannot help but effect labour conditions though obviously for the better in the long run.

Acknowledgment.

I have to reiterate my grateful thanks to those already mentioned and in particular to Mr. J. Lamb, the Director of the Tea Research Institute, for his unfailing help and encouragement.

Reference.

(1) Malayan Agricultural Journal, Vol. 32, No. 3 of July 1949.

*PATANA FIRES IN ESTATES AND WATER CATCHMENTS

R. MACLAGAN GORRIE

(Received 16th March, 1950).

(Soil Conservation Officer, Department of Agriculture, Peradeniya.)

In spite of many resolutions of committees in the past and individual efforts of owners, the control of grass fires in patana lands has proved to be a hopeless task so long as *illuk* and *mana* grasses provide the main plant cover. The amount of damage done to tea and rubber by the concentrated erosion from recently burnt patana land uphill above the plantation constitutes a serious problem. Every fire exposes a fresh earth surface which is immediately washed down the main drainage channels, gouging them out to greater depths, or flooding across any path or road to erode the crop itself. Frequently tea bushes and rubber trees are actually destroyed by fire, but this direct damage is only a very small item of loss compared with the resultant erosion.

As a result of visits to a large number of estates I am convinced that many individual owners and superintendents would be prepared to tackle the patana fire problem if they thought they had any hope of success, but there is a general atmosphere of defeatism on this subject, due largely I think to the complete failure of control measures on public patana lands. Private owners feel that the problem is beyond them and that they cannot keep fire out of their own patana blocks.

As long as *illuk* and *mana* are the main plant cover this is true. So our problem is to replace these by something less inflammable at a cost per acre which the management would consider as justifable expenditure for the area which directly concerns them.

It does not require complete afforestation to subdue these grasses but it does need a change in what the Botanists call *ecological progression*. These grasses are only a climax or final product as long as fire occurs annually and no other plant can do any better, but a trench and ridge dug truly along the contour will trap sufficient water to allow other things to grow. The plants most likely to conquer the patana grasses and replace them are trees, not other grasses. Few of the local native trees are of much use as pioneers, so we have to try foreign importations. For the hotter and lower grasslands the best choice probably is *Leucaena glauca* and for land in the mist belt or anywhere above 3,500 ft., *Acacia decurrens*. The latter tree has shown a remarkable capacity to seed itself in burnt patana in the neighbourhood of Ohiya and Hakgala. For middle elevations and land not too badly eroded, *Alstonia scholaris* should give good results as it has already done in the Hantane patana at the head of the

*The Institute does not necessarily endorse the views expressed in papers contributed by persons other than members of the staff.

Kandy Municipal Water Catchment at about 2,200 feet up to 3,000 feet. The Reserve of Udawattakele immediately above Kandy town contains profuse natural seeding of this tree. Lantana and another much detested weed *Clusia rosea* (Jamaican balsam or wild fig) might have their uses as a means of subduing the patana grasses in the middle elevations but they are useless things and once they take charge it might be difficult to replace them by anything more useful.

Economically the chief justification for afforesting patana lands is for fuel supply, and for this purpose both *Alstonia* and *Acacia decurrens* are good because they coppice freely and can therefore be cut over on a short rotation of 6 or 8 years in firewood coupes without exposing the soil unduly. The proposal therefore is that individual owners or companies who have blocks of patana in their own keeping should dig contour trenches 30 to 35 feet apart. Trenches should be 1½ feet deep and 2 feet wide at the bottom with the soil built up into a broad flat berm on the downhill side of the trench. The length is immaterial and rock surfaces should of course be left. Cross blocks of soil should be left in the trench every 10-12 feet to stop the water from slopping over in case mistakes in alignment take the line off the contour. Sowing or planting should not be done until the trench system has been tested by a heavy shower and weak and low points repaired. Sowings or transplants should be placed towards the top of the berm so that the young plants do not get drowned.

I should be glad to hear from any planter who has attempted any such work in patana land or who wants advice on this problem.

TEA CULTIVATION IN INDONESIA
(REVIEW)

T. E. WALTER.

"Handleiding voor de Theecultuur," a book of some 350 pages from the Proefstation West Java, is as much a guide to the young planter just starting his career as it is a mine of information on more complex problems for the "old hands" with years of experience in tea. Ir. A. F. Schoorel was inspired to produce a complete textbook on tea planting by the demand created by the sudden influx of large numbers of new planters who have taken the places of the more experienced ones, whose numbers were not only reduced by years of hardship in Japanese prison camps, but still further decimated by the extremists in the Civil troubles that followed. Every aspect of tea planting is covered in a readable and instructive manner and the book is copiously illustrated with 200 excellent photographs.

It is, of course, quite impossible to do justice to a book of this nature in the space of a short review, and the short-comings of this article must be excused on these grounds. I have, however, endeavoured to pick out some of the features of tea planting technique as described for comparison with Ceylon methods.

The history of tea in Java dates from 1826, when it was introduced from China; some 50 years later Assam tea appeared, and this type of tea, with hybrid varieties now forms most of the crop. The early plantations were all established by the Government, but finding that they did not pay, they were gra-

dually disposed of to private concerns and small holders; the result of this policy was that by 1941, out of a total of 335,000 acres of tea, about half were owned by small holders, with an output of only 10 per cent of the total.

Most of the tea estates are situated in W. Java, where they form more or less adjoining large districts, but there are also some scattered ones in central and East Java. They are often situated on the slopes of more or less active volcanoes, and altitudes range from 300 — 6,600 feet above sea level. Most carry secondary crops as well such as quinnine and coffee at higher elevations and rubber lower down, these being grown with the object of carrying the estates through lean periods for the tea.

As far as high shade is concerned there is a complete absence of our familiar *Grevillea robusta*. In fact shade trees and bush green manures are all leguminous. In the former category Albizzias (*e.g. A. Moluccana* and *A. sumatrana*) and lamtoro (*Leucaena glauca*) are the commonest, while dadap (*Erythrina lithosperma*), *Derris microphylla*, *Gliricidia maculata* and *Acacia decurrens* are also widely grown. *Crotalaria anagyroides* is the most favoured bush green manure although the various *Tephrosia* spp. are also commonly planted. Apart from suitability to the particular elevation, the choice of green manure trees is dictated more than anything else by their resistance or susceptibility to root diseases. These are extremely serious in Java and have been estimated to destroy some 2½ — 3 million tea bushes a year, an equivalent of about 1.000 acres of plantation. Of this astonishing total, red root disease (*Ganoderma pseudoferreum*) accounts for about half, the remainder being attributable to *Rosellinia* and *Ustulina*, the black root dieases. For this reason shade trees are regarded merely as a necessary evil below about 3,000 feet and at higher elevations they are not encouraged.

An important sphere in which work has reached a far more advanced stage than in Ceylon is that of selection, both from seed and vegetatively by internode cuttings, and work on these lines has been in progress since 1913. A further development of the latter process is the production of clonal material by grafting which has been practised as a recognised technique for some years, and I hope to have an opportunity for a detailed translation of this section at a later date.

All new planting is done on the contour system, and for simplifying this it is recommended that every 5th row be lined with an instrument, the intermediate ones being interplanted by eye. Stump planting is the usual method adopted (cf. Rubber) and it is suggested that the nursery plants be centered at 12" high some 10 days before planting out so that the dormant buds have burst by the time they are planted out.

Considerable importance is attached to ground cover, and in new clearings, more particularly at lower elevations, every attempt is made to establish creeping plants such as Vigna (*Dolichos hosei*), *Indigofera endacaphylla* and *Ageratum* spp. by seed or cuttings. Weeds such as *Oxalis*, *Borreria*, *Clitoria laurifolia* and *Eupatorium* spp. are at this stage regarded as beneficial.

The question of manuring is dealt with in considerable detail and while generalisation is difficult on this point, it appears that the composition of manures and their method of application are very different from the accepted standards here. Differences in the proportion of the nutrients are accounted for largely by differences in soil composition, and soil types are classified into five distinct groups; thus some of these types are, owing to their origin, markedly deficient in potash, and potash constituents of mixtures for these types are as high as 70 lbs. per acre, with corresponding figures for phosphoric acid 50 lbs. per acre, and nitrogen only 55 lbs. per acre. Also it is surprising to note that it is customary to manure only once or at most only twice in a pruning cycle,

the mixture being applied immediately after pruning. The latest recommendations, however, conform more to the standard of Ceylon methods. It is admitted that at least up to the war, tea plantations in Java were very inadequately manured and much original research has been done in determining the effects of deficiencies of the main elements (See Potash Deficiency in Tea Cultivation, *Tea Quarterly*, XIII, p. 139, 1940).

In conclusion it is to be regretted that such an otherwise valuable book is not provided with an index.

T. R. I. DEMONSTRATIONS IN UVA

G. D. AUSTIN

The Tea Research Institute demonstrations in Uva, now almost a feature of the Passara Sub-Station, were commenced in 1947. With the return of assistant superintendents to their normal duties on estates, it was thought that a series of demonstrations or exhibitions of specimens of the more important insect pests and diseases of tea, accompanied by informal talks on the exhibits, would help to freshen the memories of those who had been suddenly called to the war and also be of value to those who were taking to planting for the first time. It was also suggested that the demonstrations would be an occasion to attract members of the Uva planting community to its sub-station and thereby give them an opportunity of taking a keener interest in its activities.

Nettle Grubs — the chief insect pest of Uva — was the first problem which the Uva Planters' Association desired the Tea Research Institute to investigate. This was followed a couple of years later by two manurial experiments, initiated by the Institute's Agricultural Chemist, on Gonakelle Estate. The Shot Hole Borer investigation followed. Gradually T.R.I. activities in Uva covered a variety of minor experimental trials and, supplemented by a certain amount of advisory work, the Passara laboratory became the first Sub-station of the Tea Research Institute.

The few demonstrations in 1947 were confined to exhibitions of all the various species of nettle grub in their different stages; their natural enemies like parasites and predators; and spraying apparatus. The demonstrations were augmented by short talks.

With the increasing interest evinced in vegetative propagation of tea by cuttings, requests were received for demonstrations on this new venture in tea planting. All experimental work on vegetative propagation had hitherto been carried out only at St. Coombs. With the co-operation of the Plant Physiologist it was arranged that a senior assistant from St. Coombs should come down to Passara to conduct such demonstrations and the attendance at each successive meeting increased in numbers. The total attendance at both morning and afternoon sessions in 1949 was 115.

It was next decided to spread the demonstrations over a period of 3 days. The morning sessions were for the benefit of superintendents and assistants and the afternoon sessions for estate subordinate staffs.

Two daily sessions were limited to visitors from two sub-district Planters' Associations at a time. This arrangement prevented the attendance from being too large as it was particularly desired that every one who attended should

receive individual attention. Everyone could then be given an opportunity of learning the art of taking cuttings, choosing suitable planting material, planting cuttings in beds, shading, centering, etc. All this would not have been possible if the attendance had not been limited. Each stage in the procedure of vegetative propagation was preceded by a short explanatory talk on the operation which followed. Everyone was given an opportunity of asking questions and thereby eliciting information. No time limit was set to any discussion which followed. Afternoon sessions were conducted in both English and Tamil.

The following programme was adopted at the demonstrations held in February this year, and shows how visitors from the various planting districts were distributed on the three days. Figures in parenthesis indicate attendance at each demonstration.

Tuesday, February	21st	A.M.	Haputale, Koslande and Bandarawela	(14)
„	„	P.M.	Estate Subordinate Staffs	(6)
Wednesday,	„ 22nd	A.M.	Badulla and Namunukula	(34)
„	„	P.M.	Estate Subordinate Staffs	(42)
Thursday,	„ 23rd	A.M.	Passara, Lunugalla and Madulsima	(21)

After the demonstration on vegetative propagation visitors were requested to inspect the exhibits on view which were as follows :—

Fungus diseases.—Tea bushes affected with poria, brown root disease, rosellinia and ustulina; tea seedlings affected by "Bitten Off" disease. Exhibits were accompanied by photographs.

Insect Pests of Tea.—Nettle grubs (Thoseas, Natada, Parasa and Narosa), tea tortrix and lobster caterpillars.

Green Manure Pests.—Argina caterpillars, flea beetles and Arctid caterpillars on Crotalarias; spotted locust on dadaps.

Beneficial Insects.—Euplectrini parasites on nettle grubs; braconid parasites of Arctid caterpillars; the long-tailed parasite (Macrocentrus) on tea tortrix; Euproctis caterpillars feeding on the 'white blisters' of blister blight; glow worms (Lamprophorus) predaceous on the Kalutara or African Snail (Acratina), the imported cochineal insect (Dactylopius) on the prickly-pear or cactus (Opuntia).

Visitors were also invited to inspect the plots of green manures and shade trees in the grounds on which were established *Crotalaria agathifolia, C. anagyroides, C. brownei, C. grahamiana, C. usaramoensis, Tephrosia candida, T. noctiflora, T. vogelii, Desmodium gyroides, Sesbania cannabina, S. cinerescens, Indigofera arrecta, Mimosa bracaatinga,* and *Calpurnia aurea.*

The following spraying machines were also on view —

"Favouri" battery Sprayers and Charge pump, "Neo-Leo" knapsack Sprayers — Air retaining models, Four Oaks Kent pneumatic sprayers, a single "Nesthill' Sprayer — originally designed by Mr. Redman King, a former T.R.I. Entomologist.

A good number of the above exhibits are always maintained at the Passara Sub-Station and visitors are welcome especially on visitors' days which are the *second* and *last* Wednesday in the month.

At the next demonstration, to be held towards the middle of the year, it has been suggested that one of the items on the programme should be an illustrated talk on some of the attempts made to control indigenous pests by biological methods and especially the importation of beneficial insects from outside the island. Some of the attempts in the past were inspired by resolutions passed at meetings of upcountry districts planters' associations.

MINUTES OF A MEETING OF THE BOARD OF THE TEA RESEARCH INSTITUTE OF CEYLON HELD ON 1st APRIL, 1950, AT 9-30 A.M. AT THE OFFICES OF THE PLANTERS' ASSOCIATION OF CEYLON, 113, STEUART PLACE, COLPETTY, COLOMBO.

Present.—Mr. R. C. Scott, C.B.E. (Chairman); The Secretary to the Treasury (Mr. C. E. Jones, C.M.G., C.C.S.); The Chairman, Planters' Association of Ceylon (Mr. E. G. Groves); The Chairman, Agency Section, Planters' Association of Ceylon (Mr. G. K. Newton); Messrs. H. de T. Wilkinson Kay, J. C. Kelly, R. Singleton Salmon, W. Neal de Alwis, J.P., U.M., Leo B. de Mel, J.P., U.M., Errol Jayawickrama, V. G. W. Ratnayake, M.P., W. L. Ross, E. N. Ewart and J. Lamb (Acting Director and Secretary).

Mr. G. B. Portsmouth, Plant Physiologist, was present by invitation.

A letter from the Director of Agriculture (Mr. D. Rhind) expressing his inability to be present was tabled.

2. MEMBERSHIP.

(a) **Board.**

The Chairman reported that:—

(i) Mr. G. K. Newton, on assuming the Chairmanship of the Agency Section of the Planters' Association of Ceylon from Mr. R. J. Hartley, became an Ex-officio Member of the Board as from 31st December, 1949.

(ii) Mr. J. C. Kelly was nominated by the Agency Section of the Planters' Association of Ceylon to fill the vacancy created by the departure of Mr. W. H. Attfield on furlough with effect from 31st March, 1950.

(iii) Mr. H. S. Hurst, who had proceeded on leave and had now returned to the Island, would resume his seat replacing Mr. W. L. Ross who had been acting for him.

(b) **Experimental Sub-Committee.**

The Chairman said that Mr. Hurst would resume his place on this Committee. Mr. S. Bolster had been acting for him.

The Chairman thanked all outgoing members for the useful services they had rendered to the Board during their tenure of office and extended a cordial welcome to the new members.

3. VISITING AGENT'S REPORT.

The Chairman said that copies of this report had been circulated to Members, and pointed out it had not yet been discussed by the Estate and Experimental Sub-Committee. It was proposed to hold a Meeting of this Committee in the very near future. It will be noted that the appointment of the Field Assistant as approved at the last Meeting of the Board has been made.

4. **BLISTER BLIGHT.**

The Chairman said he was glad to be able to inform members that the Amendments to the Tea Control Act has passed both Houses and was on the Order Book of the House of Representatives for April 4th. This meant that the release of Rs. 150,000/- for work in connection with large scale experiments to combat this disease was assured. Mr. Lamb was then asked to give an account of developments in blister blight control work, and reported as follows :—

(i) **Programme of Work.**—This followed the lines indicated in the report to the Tea Controller, copies of which had been issued to all members of the Board.

(a) **200 acre Spraying Experiment.**—With the kind co-operation of the Consolidated Tea Estates Company Limited, an area of 200 acres of Kataboola Estate, Kotmale, had been made available for spraying experiments during the south west monsoon. The site was most suitable because it offered a variety of problems and a relatively very high incidence of blister blight.

(b) It was essential that this experiment should be closely supervised. Messrs. George Steuart & Co. have been unable to supply an S.D. and the Colombo Commercial Co. had very kindly agreed to loan one of their S.Ds, Mr. N. M. Lindsay, for six months. Mr. Lindsay was a Graduate in Agriculture, Aberdeen University, and had also attended a one year post-graduate course in agriculture. Mr. Lindsay would reside on Kataboola Estate and work as a member of the Superintendent's staff.

(c) An experiment on purely agricultural methods as distinct from spraying methods of control had also been laid out on Kataboola Estate and would also be supervised by Mr. Lindsay.

(ii) Apart from the Kataboola experiment, eight other estates covering the Ramboda, Nuwara Eliya and Agrapatna districts had agreed to carry out 50-acre spraying experiments during the south west monsoon. These experiments were to be carried out at the expense of the estates concerned. The Institute's commitments were :—

(1) To train the labourers required for the spray gang. Lines were being built on St. Coombs to accommodate these labourers for the training period.

(2) To arrange for a two or three day course of instruction for the Superintendents of these estates.

(3) To order the necessary equipment and to endeavour to obtain it free of import duty.

(iii) **Work on St. Coombs.**—This would fall under two main headings :—

(a) **Development of Spray Equipment.**—Mr. James Landreth had been appointed to the Staff as Engineer. Mr. Landreth had sailed for the United Kingdom on short leave and would

(1) order the equipment necessary for the Workshop.

(2) visit Plant Protection, Pest Control, Shell Company's Research and Development Department in Holland, the Engineering Department of Long Ashton Research Station, and various manufacturers of spraying machinery.

(b) **Tests with fungicidal preparations.**—A large scale experiment was being planned to test the effect of long term application of copper fungicides, both with respect to quality and spray residue. Dr. Swarbrick of the Research and Development Department of the Shell Organisation had arranged to send a Plant Pathologist to work at St. Coombs for six months. This Pathologist, Dr. Pfaeltzer,

was expected to arrive in Ceylon within the next few days. Arrangements were being made to test some 150 fungicidal preparations, including all those that had been offered for sale as proprietary preparations in the world market and a number of coded formulations developed in the Shell Company's laboratories. A field assistant from the Passara Sub-Station had been transferred to St. Coombs to assist Dr. Pfaeltzer. The most successful of these 150 compounds would later be tested on a larger scale, possibly in plots of about 50 acres in extent.

(iv) Finally, Mr. Lamb referred appreciatively to the help given by Agency Houses, Engineering Firms and Estates in planning the blister blight control work. Every request made by the Institute for assistance had been granted.

The Chairman said he wished to endorse the remarks made about the excellent co-operation the Institute had received from the Hon'ble the Minister of Agriculture and Lands, the Agency Houses, the Consolidated Estates Co., Ltd., the Engineering Firms and everyone else concerned.

Referring to the importation of equipment and other material needed for these experiments, he said that it was most important that these should be allowed free of duty and also that they be released with the least possible delay. He proposed that the Board of the Tea Research Institute requests the Hon'ble the Minister of Finance to consider the desirability of allowing *all* spraying machinery, equipment, and accessories, together with fungicides, to be used against the blister blight disease of tea into the Island free of duty and without delay.

5. **SENIOR STAFF.**

The Chairman said that Dr. F. Haworth had accepted the post of Agricultural Chemist. He was at present on six month's leave in the United Kingdom but was prepared to curtail his leave if necessary. It was expected he would arrive in Ceylon in July or August. Arrangements had been made for Dr. Haworth to spend some time at East Malling Research Station to learn the technique for investigation of minor element status of plants.

6. **JUNIOR STAFF.**

Small Holdings Officer, Southern Province.—It was reported that following the approval of all members Mr. M. V. de Silva has been appointed Small Holdings Officer, Southern Province.

(Sgd.) J. LAMB,
Acting Secretary.

Tea Research Institute of Ceylon,
St. Coombs, Talawakelle,
22nd May, 1950.

MINUTES OF A MEETING OF THE BOARD OF THE TEA RESEARCH INSTITUTE OF CEYLON HELD AT THE OFFICES OF THE PLANTERS' ASSOCIATION OF CEYLON, THE LAWN, 113, STEUART PLACE, COLPETTY, COLOMBO, ON 23rd JUNE, 1950, AT 2-30 P.M.

Present.—Mr. R. C. Scott, C.B.E. (Chairman), Sir Charles Jones, C.M.G. C.C.S. (Secretary to the Treasury), Mr. G. K. Newton (Chairman, Agency Section, Planters' Association of Ceylon), Messrs. H. S. Hurst, Errol Jayawickreme, Leo B. de Mel, J.P., U.M., J. C. Kelly, H. de T. Wilkinson Kay, V. G. W. Ratnayake, M.P., W. Neal de Alwis, J.P., U.M., F. A. Bond, and J. Lamb (Director and Secretary).

Letters from Messrs. D. Rhind (Director of Agriculture), R. C. L. Notley (Chairman, Planters' Association of Ceylon) and R. Singleton Salmon, C.B.E., expressing inability to be present were tabled.

1. The Notice convening the Meeting was read.

The Chairman referred to the death of Dr. Norris in South Africa and said :--

"I rise to pay our sad but honourable tribute to the memory and work of Dr. Roland V. Norris, D.Sc., who was Director of the Tea Research Institute of Ceylon from 1929 until the day of his death, 28th April, 1950. He has been responsible, largely, for the development of the Institute from its early days to its present considerable quarters and status.

.....

I feel I cannot do better than reiterate words used by Mr. J. Lamb, our Acting Director, which appeared in the "Daily News" of May 22nd, 1950, to the effect that the considerable and attractive quarters at St. Coombs, as well as the status and influence to which the Institute has aspired, will be a lasting memorial of Dr. Norris's perseverance and industry. I trust it will be the case that the Board of the Institute will agree that some form of Memorial at St. Coombs should record the name of Dr. Roland Victor Norris as a Director whose services to the Tea Industry of Ceylon were outstanding."

He moved that the Board's condolence be passed to Mrs. Norris and her children.

The meeting stood in silence as a mark of respect.

2. The Chairman pointed out that he considered the time had arrived to appoint a successor to the late Dr. R. V. Norris, D.Sc., as Director. He said that, at his request, Mr. Lamb had prepared a memorandum of his record as a scientist ; this he read in full. He continued by saying that Mr. Lamb had been with the Institute for 16 years, and therefore, that his experience was of very great value ; additionally, that he had been in close touch with Mr. Lamb during the seven months he had been acting Director, and had found him to be a scientist with a profound knowledge of many branches of science, and, moreover, ready and anxious to apply his knowledge in practice. He had, too, adapted himself to the administrative aspect.

It was proposed by Mr. H. S. Hurst and seconded by Mr. Neal de Alwis that Mr. Lamb, M.S.c., should be appointed Director of the Tea Research Institute of Ceylon in succession to the late Dr. R. V. Norris, D.Sc. On being put to the Board, the proposal was accepted unanimously.

On his return to the Meeting Mr. Lamb was informed that he had been appointed Director on the terms outlined above.

Mr. Lamb thanked the Chairman and the Board for the confidence they had shewn by appointing him to the Directorship and said he would endeavour to justify it in full measure.

3. MEMBERSHIP OF THE BOARD AND COMMITTEES.

The Chairman reported that :—

(a) Mr. R. C. L. Notley became an ex-officio member of the Board, in place of Mr. E. G. Groves, on his assuming Chairmanship of the Planters' Association of Ceylon as from 20th April, 1950. He also replaced Mr. Groves on the Finance Sub-Committee.

(b) Mr. F. A. Bond returned from leave, was nominated by the Agency Section of the P.A. and relieved Mr. E. N. Ewart who had been acting for him.

He thanked the outgoing members for their services to the Board and extended a welcome to the new members.

He next offered the congratulations of the Board to Sir Charles Jones and to Mr. R. Singleton Salmon, C.B.E., on the honours recently conferred on them by H.M. the King. This was received with applause.

4. SENIOR STAFF.

(a) The Chairman reported that Mr. J. Landreth, the newly appointed Engineer, returned from Home Leave on the 29th May and had assumed duties.

(b) The Chairman reported that Dr. F. Haworth, the new Agricultural Chemist, will sail from England on the 7th of July and arrive in Ceylon about the end of July. He had been to the East Malling Research Station where he had obtained information on the most recent technique for investigation of minor element deficiencies. The Director had mentioned to him that he nad received a very favourable report on Dr. Haworth from Dr. Tubbs.

5. LOW-COUNTRY SUB-STATION.

The Chairman said that on April 17th the full Low-Country Sub-Station Committee, comprising three members from the Board and those co-opted from all Low-Country District Planters' Associations inspected Nivitigalakele Estate.

The Committee reported in favour of the proposed acquisition of Nivitigalakele for the Tea Research Institute of Ceylon Sub-Station. A valuation was called for and Mr. J. D. Farquharson valued the property and submitted a report on the 21st April.

A further meeting of the Board Sub-Committee together with the Finance Sub-Committee was held on May 19th prior to a joint meeting with the Rubber Research Scheme Board on May 20th. Minutes of the former meeting had been circulated.

6. RESEARCH STUDENTS.

The Chairman reported that Mr. D. V. W. Abeygoonewardene, B.Sc., had been given a research studentship for a period of 6 months. He was to assist Dr. Pfaeltzer of the Shell Laboratory, Amsterdam, who was working on the Blister Blight problem.

7. ST. COOMBS CADDAY.

The Chairman reported that the Agreement to lease the St. Coombs Cadday building to Mr. R. P. Arnolis Silva of Dondra was signed in the morning at Messrs. Julius & Creasy's office. This was in accordance with the resolution passed by the Board on 17th December, 1948.

8. ANY OTHER BUSINESS.

(i) Blister Blight.

(a) The Chairman reported that Rs. 150.000/- being the payment from the Tea Control Funds for the first year's work on Blister Blight was received on the 8th of May. The Tea Controller had informed the Director that it was proposed to increase the Tea Control Cess to 10 cents per 100 lb. with a view to making a grant of Rs. 150.000 a year in the next three years. These contributions would be made available only at the end of each control year. The next contribution was to be made available in April 1951. As regards the mode of accounting for these payments the matter was left to the discretion of the Tea Research Institute but annual accounts would have to be forwarded to the Tea Controller for submission to the Minister of Finance.

(b) **Import Duty on Spraying Machinery and Equipment.**

The Chairman said that he was pleased to report that the Board's resolution on the waiving of duty on spraying machinery and fungicides to be used for blister blight control had met with approval of the Government.

(c) **Spraying Experiments.**

The Director said that the large scale spraying experiments at Kataboola had been set going and much work was being done there. He also said that Dr. Dike of the Metallo Chemical Refining Company, London, was testing out a dusting and mist-blowing machine. This machine appeared to be very promising. It was being tested on Castlereagh Estate, Dickoya. Experiments were also being carried out on Mattakelle Estate. Dr. Pfaeltzer of the Shell Company's Research and Development Organisation was testing some 140 different fungicides including many of the new types.

The Director said he hoped to arrange a field day in the near future so that the industry could see some of these activities.

In reply to a question, the Director stated that due to the abnormal weather conditions which had prevailed from the beginning of the year, the outbreak of Blister Blight had been delayed. Experiments at St. Coombs had also been somewhat upset by the weather.

(ii) **Food Production.**

The Chairman reported that application had been made on the 14th June, 1950, to the Minister of Agriculture and Lands for St. Coombs to be exempted from the obligation of food production as has been granted to the Coconut Research Scheme.

(iii) The Chairman, before closing the meeting, said he wished to take the opportunity of expressing to Sir Charles Jones the thanks of the Board for his services by his regular attendance and very valuable advice. He wished him and Lady Jones happiness in their retirement.

Sir Charles Jones said that it was always a pleasure to him to attend meetings of the Tea Research Institute and Rubber Research Scheme Boards and thanked the Chairman and members for their good wishes.

The meeting ended with a vote of thanks to the Chair.

(Sgd.) J. LAMB,
Secretary to the Board.

Tea Research Institute of Ceylon,
St. Coombs,
Talawakelle.

MINUTES OF A MEETING OF THE BOARD OF THE TEA RESEARCH INSTITUTE OF CEYLON HELD AT ST. COOMBS, TALAWAKELLE, ON 26th & 27th JULY, 1950.

Present (26th).—Mr. R. C. Scott, C.B.E. (Chairman); The Chairman, Agency Section of the Planters' Association (Mr. G. K. Newton); The Chairman, Planters' Association of Ceylon (Mr. R. C. L. Notley); The Director of Agriculture (Mr. D. Rhind), Messrs. W. Neal de Alwis, J.P., U.M., J. C. Kelly, F. A. Bond, Errol Jayawickreme, V. G. W. Ratnayake, M.P., and J. Lamb (Director and Secretary). Mr. R. Singleton Salmon was present at 2.30 p.m.

Letters regretting inability to be present were received from Mr. L. B. de Mel and Mr. T. D. Perera, C.M.G., C.C.S. (Secretary to the Treasury, representing the Hon'ble the Financial Secretary).

In addition to the discussions recorded in the following minutes, Members of the Board took the opportunity afforded by meeting at St. Coombs of seeing some of the experimental work in progress, inspecting buildings and meeting all members of the Staff.

1. The Notice convening the Meeting was read.

2. The Minutes of the Meeting of the Board held on 23rd June, 1950, were confirmed.

3. MEMBERSHIP OF THE BOARD.

The Chairman reported that Mr. T. D. Perera, C.M.G., C.C.S., had been nominated by the Hon'ble the Minister of Finance to represent him on the Board as from 10th July, 1950.

4. STAFF.

Retiring Age.

The Director recommended that a retiring age should be fixed for ALL members of the staff. After some discussion it was resolved that the normal retiring age should be fixed at 55 years. The Board reserved the right to request any officer to stay on for a further five years if an extension of service was considered desirable.

5. FINANCE.

The Chairman informed the Meeting that the Auditors' Report and Accounts for 1949 had been very fully considered by the Finance Sub-Committee and that it was decided to recommend to the Board their acceptance together with the proposals made by Mr. Kelly.

The Auditors' Report and Accounts for 1949 were accepted on the proposal of Mr. J. C. Kelly which Mr. H. de T. Wilkinson Kay seconded.

Mr. J. C. Kelly said he wished that an appreciation of the good work carried out by the Accounts Department should be recorded. Accepted.

7. ANY OTHER BUSINESS.

(a) **Recreation Hall for Junior Staff.**

The Chairman asked for the Board's approval for the construction of such a hall as a memorial to the late Director, Dr. R. V. Norris.

This was unanimously approved.

It was finally decided that expenditure to the extent of Rs. 25,000 be incurred on a Club House (Recreation Room) for the Junior Staff as the first part of a scheme to serve as a Memorial to the late Director, Dr. R. V. Norris, D.Sc.

(b) **Extension to Laboratory Buildings.**

The Chairman said that Members had inspected the laboratory and offices and details of the proposed extension and alterations to the building had been shown to them.

The Director stressed that the most essential parts of the scheme were the extension to the Library, the Administrative block and the store room.

After discussion it was agreed that the Director should consult a competent architect and put up a comprehensive scheme with full details of layout and cost of the suggested extensions and improvements to the laboratory and office and also of the proposed Club House for consideration by the Board.

(c) **The Late Dr. R. V. Norris.**

The Chairman gave members the latest information regarding the last days and the passing away of the late Dr. Norris which he had received from S. Africa.

(d) **Conference.**

The Chairman said that the Director wished to make arrangements for the next T. R. I. Conference which was due to be held in 1951 and suggested that as the previous Conference was held in Kandy it should be held at Radella or Nuwara Eliya.

After some discussion it was agreed that the Director should make the necessary arrangements to hold the Conference in Nuwara Eliya early next year, i.e. 1951.

(**Note**:—The Director now considers it desirable to hold the Conference towards the end of November, 1950).

Before concluding the meeting the Chairman expressed his appreciation of the excellent attendance and the spirit of loyalty and co-operation shown by all members.

Mr. R. Singleton Salmon on behalf of all members of the Board thanked the Director and the Senior Staff for the arrangements made for their accommodation and the hospitality extended to them.

The meeting ended with a vote of thanks to the Chair.

(Sgd.) J. LAMB,
Secretary.

Tea Research Institute of Ceylon,
St. Coombs, Talawakelle,
14th October, 1950.

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